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		REVISION 02
		Page 1 of 78

DPS-02

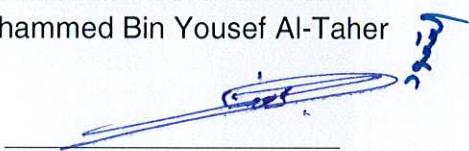
DISTRIBUTION PLANNING STANDARDS

DESIGN GUIDELINE OF UNDERGROUND LOW

VOLTAGE NETWORK TO SUPPLY CUSTOMERS

Approved by:

Executive Director
Distribution Services Sector
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	DISTRIBUTION PLANNING STANDARD Design Guideline Of Underground Low Voltage Network To Supply Customers	ISSUE DATE: September, 2015
	REVISION 02	
		Page 2 of 78

DPS-02

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الشركة السعودية للكهرباء

Saudi Electricity Company

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ISSUE DATE:

September, 2015

REVISION

02

Page 3 of 78

TABLE OF CONTENTS

SN	Description	Page
1	INTRODUCTION	4
2	SCOPE	4
3	NEW FEATURES	4
4	DEFINITIONS	5
5	STANDARD SERVICE VOLTAGES	7
6	LV UNDERGROUND MATERIALS	8
6.1	DISTRIBUTION SUBSTATIONS	8
6.2	LV DISTRIBUTION PANELS	9
6.3	LV DISTRIBUTION PILLARS	9
6.4	LV CABLES	10
6.5	LV SERVICE CONNECTIONS CIRCUIT BREAKERS	11
6.6	KWH METERS	12
6.7	METERS BOXES	12
7	LOCATIONS OF LV DISTRIBUTION PILLARS	13
8	LOCATIONS OF DISTRIBUTION SUBSTATIONS SITES	14
9	UNDERGROUND LOW VOLTAGE NETWORK CONFIGURATION	15
10	PRINCIPLES OF DESIGN	18
10.1	CUSTOMER'S COINCIDENT DEMAND LOAD	18
10.2	COINCIDENT DEMAND LOAD ON LV NETWRK ELEMENTS	18
10.3	EQUIPMENT CHARACTERISTICS (FULL RATING & FIRM CAPACITY)	19
10.4	VOLTAGE DROP CALCULATION	21
10.5	GENERAL PRINCIPLES OF DESIGN	25
11	STEP BY STEP DESIGN PROCEDURES	29
12	LV CABELS DE-RATING FACTORS	35
13	SUPPLY METHOD FOR LV LARGE METERS (300 , 400 , 500 , 600 , 800 AMP)	37
14	SUPPLY METHOD FOR LV CUSTOMERS BY PRIVATE DISTRIBUTION SUBSTATIONS	43
15	SPECIAL CASE : LV NETWORK WITH RING SYSTEM	46
16	SPECIAL CASE : LV NETWORK FOR HAJJ AREA	47
17	SPECIAL CASE : LV NETWORK FOR RANDOM AREA	47
18	SPECIAL CASE : LV NETWORK FOR COMMERCIAL CENTER	47
19	SPECIAL CASE : LV NETWORK FOR COMMERCIAL OFFICES BUILDINGS	47
20	SPECIAL CASE : LV NETWORK FOR COMPLEX OF WORKSHOPS	48
21	POWER SUPPLY OF NEW PLOT PLAN	48
22	REINFORCEMENT OF UNDERGROUND LOW VOLTAGE NETWORK	48
23	EXEMPTION OF DISTRIBUTION SUBSTATION LOCATION	48
24	ADVANTAGEOUS MODULES AND TABLES	49
25	TYPICAL LAYOUT FOR UNDERGROUND LOW VOLTAGE NETWORK	50
26	TYPICAL DISTRIBUTED LOADS PER OUTGOING OF THE SUBSTATION	51
	APPENDIXES	52

	الشركة السعودية للكهرباء Saudi Electricity Company	DISTRIBUTION PLANNING STANDARD DPS-02
	DISTRIBUTION PLANNING STANDARD Design Guideline Of Underground Low Voltage Network To Supply Customers	ISSUE DATE: September, 2015
	REVISION 02	
		Page 4 of 78

1.0 INTRODUCTION

This document represents the new SEC Distribution Planning Standards (DPS) for Underground Low Voltage Networks. This guideline should be applied and followed in place of Section No.3 named (Low Voltage Planning Criteria) in the existing SEC Distribution Planning Standards (DPS , Rev. 01 , Dated: March 2004).

2.0 SCOPE

This guideline describes the standards and criteria for electrical design and planning of underground low voltage network and its layout to deliver the sufficient supply of electricity to new customers' loads within the defined standards limits of voltage and loading , and to maintain the reliability of power supply under all normal operating load and voltage conditions within the defined standards limits. It is intended to assist the planning engineers and field personnel to achieve standardization in design and planning and to ensure a satisfactory and economical level of service. It covers all types of supplying new customers with low voltage underground network including (used LV materials , configurations types , design principles and procedures , calculations , etc).

3.0 NEW FEATURES

The Major New Features in this guideline are :

1. LV Underground Materials
2. Step by Step Design Procedures
3. Supply Method for LV Large Meters (300 , 400 , 500 , 600 , 800 Amp)
4. Supply Method for LV Customers with Load more than 800 Amp by Private/Dedicated Distribution Substations
5. Special Case : LV Network With Ring System
6. Special Case : LV Network for Hajj Area
7. Special Case : LV Network for Random Area
8. Special Case : LV Network for Commercial Center
9. Advantageous Modules and Tables
10. Typical Layout for Underground Low Voltage Network
11. Typical Distributed Loads per Outgoing of the Substation

	الشركة السعودية للكهرباء Saudi Electricity Company	DISTRIBUTION PLANNING STANDARD DPS-02
	DISTRIBUTION PLANNING STANDARD Design Guideline Of Underground Low Voltage Network To Supply Customers	ISSUE DATE: September, 2015
		REVISION 02
		Page 5 of 78

4.0 DEFINITIONS

Customer :

It is any entity that purchases electrical power from a power utility. It is the owner of the building/facility supplied by SEC's power system. It is the owner of the supply request submitted to SEC to get electrical power.

Customer Interface Point :

It is the point at which a customer's load is connected to the SEC's power system. This shall normally be taken as the load side of the customer metering installation. The SEC shall normally be responsible for operating and maintaining all equipment up to the supply of this interface point. The customer shall be responsible for all equipment on the load side of this interface point.

Unit :

It is intended for the building's unit. Each unit should be used by one consumer. Each building can contain a single unit or multiple units. Each unit should be supplied by one KWH Meter according to SEC regulations.

Supply Request :

It is the request applied by the customer to get electric power supply from SEC's power system. It can contain a single building or multiple buildings and subsequently it can contain a single unit or multiple units and subsequently it can contain a single KWH Meter or multiple KWH Meters.

Connected Load (CL) :

It is the sum of all the nameplate ratings of all present and future electrical equipments & installations belongs to the customer's building/facility and could be used by the customer in future. It is to be estimated before applying any demand factor or diversity factor. It is expressed in Volt-Amperes (VA).

Demand Load (DL) :

It is the individual maximum demand load of a customer's building's unit usually occurring during the peak loading period (either estimated or measured). It must be calculated from the connected load of that customer's building's multiply by the approved demand factor of that customer's building's unit. It is expressed in Volt-Amperes (VA).

	الشركة السعودية للكهرباء Saudi Electricity Company	DISTRIBUTION PLANNING STANDARD DPS-02
	DISTRIBUTION PLANNING STANDARD Design Guideline Of Underground Low Voltage Network To Supply Customers	ISSUE DATE: September, 2015
		REVISION 02
		Page 6 of 78

$$\text{Demand Load} = \text{Connected Load} \times \text{Demand Factor}$$

Demand Factor (DF):

It is the ratio of the Demand Load of a customer's building's unit to the Connected Load of that customer's building's unit.

$$\text{Demand Factor} = \frac{\text{Demand Load}}{\text{Connected Load}}$$

Total Demand Load (TDL):

It is the total (non-coincident) demand load of a customer's building with multiple units. It is the non-coincident summation of all individuals demand loads of all units belongs to that customer's building. It is expressed in Volt-Amperes (VA).

$$\text{Total Demand Load} = \Sigma(\text{all individuals demand loads})$$

Coincident Demand Load (CDL):

It is the maximum (coincident) demand load of a customer's building with multiple units. It must be calculated from the Total Demand Load of that customer's building multiplying by the approved coincidence factor of that customer's building. It is expressed in Volt-Amperes (VA).

$$\text{Coincident Demand Load} = \text{Total Demand Load} \times \text{Coincidence Factor}$$

Coincidence Factor (CF) :

It is the ratio of the Coincident Demand Load of a customer's building with group of units (KWH Meters) to the Total Demand Load of that customer's building both taken at the same point of supply for the same time.

$$\text{Coincidence Factor} = \frac{\text{Coincident Demand Load}}{\text{Total Demand Load}}$$

Diversity Factor :

It is the inverse of the Coincidence Factor.

Contracted Load:

It is the capacity of power supply (in Volt-Amperes) equivalent to the circuit breaker rating (in Amperes) provided to the customer's KWH Meter. Supply connection fees and insurance charges are based on contracted load.

	الشركة السعودية للكهرباء Saudi Electricity Company	DISTRIBUTION PLANNING STANDARD DPS-02
	DISTRIBUTION PLANNING STANDARD Design Guideline Of Underground Low Voltage Network To Supply Customers	ISSUE DATE: September, 2015
	REVISION 02	
		Page 7 of 78

Low Voltage (LV) :

It is a class of nominal system voltages of 1000 Volts or less.

Nominal Voltage :

It is the voltage value, by which a system is designated and to which certain operating characteristics of the system are related.

Service Voltage :

It is the voltage value at the Customer's interface, declared by the Power Utility. This is generally expressed as a voltage range, in terms of a nominal voltage with plus and minus percentage variations.

Voltage Drop (VD) :

It is the difference in voltage between one point in a power system and another, typically between the supply substation bus and the extremities of a network. This is generally expressed as a percentage of the nominal voltage.

Firm Capacity :

Firm Capacity of any elements in LV Distribution Network is 80% of that element's rating.

5.0 STANDARD SERVICE VOLTAGES

The voltages listed in Table (1) shall be used as standard service voltages at the interface with power customers. The service voltage shall be maintained within the range defined by the indicated lowest and highest values, under steady state and normal system conditions and over the full loading range of the system. Where two voltages are listed e.g., 400/230 V the lower value refers to the phase to neutral voltage. All other values are phase-to-phase voltages

Table (1)

Nominal Voltage	Lowest Voltage	Highest Voltage
400/230 V	380/219 V	420/241 V
380/220 V	361/209 V	399/231 V
220/127 V	209/121 V	231/133 V
Percentage Limits	- 5%	+ 5%

	الشركة السعودية للكهرباء Saudi Electricity Company	DISTRIBUTION PLANNING STANDARD DPS-02
	DISTRIBUTION PLANNING STANDARD Design Guideline Of Underground Low Voltage Network To Supply Customers	ISSUE DATE: September, 2015
		REVISION 02
		Page 8 of 78

6.0 LV UNDERGROUND MATERIALS

6.1 DISTRIBUTION SUBSTATIONS

This paragraph sets out standards for determining the Size, Loading, Dimension and Location of Distribution Substation in SEC. The purpose is to provide sufficient distribution and low voltage network capacity to enable permanent connection to all customers demand loads at foreseen future.

a) Unit Substation

A unit substation is commonly used substation in SEC. It combines distribution transformer and LV distribution panel in a single transportable unit. The unit substation is fed from a separate ring main unit. The ring main unit is not an integral part of the unit substation.

General characteristics of the unit substation are shown in Table (2). Detailed materials specifications for Unit Substations are referred to SEC Distribution Materials Specification No. (56-SDMS-01, Rev.01) and No. (56-SDMS-03, Rev.00) with its latest updates.

b) Package Substation

The package substation is convenience to install and occupies lesser space. It consists of Ring Main Unit, Distribution Transformer and Low Voltage Distribution Panel combined in a single unit.

General characteristics of the package substation are shown in Table (2). Detailed materials specifications for package substations are referred to SEC Distribution Materials Specification No. (56-SDMS-02, Rev.01) and No. (56-SDMS-04, Rev.00) with its latest updates.

c) Room Substations

Separate Transformers and Low Voltage Distribution Boards also are available as well as 13.8 KV Ring Main Unit. These are to be used in indoor substations. As indoor substations usually serves large spot loads, the combinations of transformers and Low Voltage. Distribution Board may differ from those of package unit substations, but the ratings are similar.

	الشركة السعودية للكهرباء Saudi Electricity Company	DISTRIBUTION PLANNING STANDARD DPS-02	
	DISTRIBUTION PLANNING STANDARD Design Guideline Of Underground Low Voltage Network To Supply Customers	ISSUE DATE:	REVISION
	September, 2015	02	
		Page 9 of 78	

6.2 LV DISTRIBUTION PANELS

Low voltage distribution panels to be used in the distribution substations. The panel contains 400A molded case circuit breakers (MCCB) for out-going circuits. 400A MCCB according to SEC specification No. 37-SDMS-02 latest revision shall be already installed for each outgoing feeder. MCCB outgoing terminals shall be suitable for direct connection of 300mm² Al. cable.

Table (2)

Secondary Voltage (V)	400/230				231/133			
Transformer Rating (KVA)	300	500	1000	1500	300	500	1000	1500
L.V. Panel Rating (A)	500	800	1600	2500	800	1600	3000	4000
Number of Outgoing MCCB's	2	4	8	10	4	8	12	14
Rating of Outgoing MCCB (A)	400	400	400	400	400	400	400	400

Detailed materials specifications for LV Distribution Panels are referred to SEC Distribution Materials Specification No. (31-SDMS-01, Rev.03) and No. (31-SDMS-05, Rev.00) with its latest updates.

6.3 LV DISTRIBUTION PILLARS

Distribution Pillars provide above-ground access for service connections from LV main feeder. Its Bus bars has a rated normal continuous current of 400 Amps. The Distribution Pillar is equipped for seven (7), 3-Phase, 4-Wire, Aluminum Cable circuits. Two (2) circuits for the in-coming and five (5) circuits for the out-going. The two (2) in-coming circuits is located on each side of the Pillar. The five (5) out-going circuits in the middle are equipped with NH Fuse Ways with rated current of 200 Amps. LV fuse links knife type NH of current rating 200 amps shall be installed. The incoming circuit terminals are suitable for fixing Aluminum Cable of size 300 mm² or 185 mm² with the use of cable lugs. The outgoing circuit terminals are suitable for fixing Aluminum Cable of size 185 mm² or 70 mm² with the use of cable lugs. The incoming circuit terminals are used for LV main feeder. The outgoing circuit terminals of distribution pillar are used for service connection to the customers.

	الشركة السعودية للكهرباء Saudi Electricity Company	DISTRIBUTION PLANNING STANDARD DPS-02	
	DISTRIBUTION PLANNING STANDARD Design Guideline Of Underground Low Voltage Network To Supply Customers	ISSUE DATE:	REVISION
	September, 2015	02	
		Page 10 of 78	

Detailed materials specifications for LV Distribution Pillars are referred to SEC Distribution Materials Specification No. (31-SDMS-02, Rev.01) with its latest updates.

6.4 LV CABLES

The 4 x 300 mm² AL/XLPE cable is the standard for LV main Feeder. Two sizes of cable 4 x 185 mm² & 4 x 70 mm² AL/XLPE shall be used for service connections. Three-phase four wires cable are provided as standard.

Detailed materials specifications for LV Cables are referred to SEC Distribution Materials Specification No. (11-SDMS-01, Rev. 02) with its latest updates.

The LV cables current ratings in (A) and equivalent capacities in (KVA) at different low voltages are given in Table (3) below :

Table (3)

LV Cable Size	Rating (Amps)	Rating (KVA) for Different Voltages (V)		
		Standard Nominal Voltages		
		400	380	220
4 X 300 mm ² AL	310	215	204	118
4 X 185 mm ² AL	230	159	151	88
4 X 70 mm ² AL	135	94	89	51

Note: These ratings are based on calculations derived from IEC 287 (1982) : “ Calculation of the Continuous Current Rating of Cables ”. They are based on the cable characteristics indicated in Table (4) and on the standard rating conditions indicated in Table (5) below. These results are based on data for typical cable types. For more precise data, refer to the specific cable supplier. Correction factors for deviation from these conditions are indicated in Table (23) & Table (24) & Table (25). Where two or more circuits are installed in proximity, the load rating of all affected cables is reduced.

The LV Cables Characteristics (AC resistance and reactance) values are given in Table (4) below :

Table (4)

LV Cable Size	R _{AC} 20 °C Ohms / km	X ₁ (60HZ) Ohms / km
4 X 300 mm ² AL	0.130	0.090
4 X 185 mm ² AL	0.211	0.091
4 X 70 mm ² AL	0.568	0.095

	الشركة السعودية للكهرباء Saudi Electricity Company	DISTRIBUTION PLANNING STANDARD DPS-02
	DISTRIBUTION PLANNING STANDARD Design Guideline Of Underground Low Voltage Network To Supply Customers	ISSUE DATE: September, 2015
		REVISION 02
		Page 11 of 78

Note: Impedance values are ohms per km per phase for each cable type. Multiply by square root of 3 to derive equivalent line values. Indicated values are positive / negative sequence impedance values. The DC resistance values are based on IEC 228: conductors of Insulated Cables. The AC resistance values take account of skin effect and are based on data for typical cable types. For more precise data refer to the specific cable supplier. The reactance values are based on a trefoil conductor configuration for single core cables. They are based on data for typical cable types. For more precise data refer to the specific cable supplier.

Standard Cable Rating Conditions

Cable ratings given in Table (3) are based on the following standard conditions mentioned in Table (5) below :

Table (5)

Ambient Temperature Direct Buried/ Underground Ducted, at depths of one (1) meter and more	35 °C.
Soil Thermal Resistivity, at depths of one (1) meter and more	2.0 °C.m/w
Maximum Continuous Conductor Operating Temperature (XLPE)	90 °C
Maximum Short Circuit Conductor Temperature – 5 second Maximum Duration (XLPE)	250 °C
Loss Load Factor – Daily (Equivalent Load Factor = 0.88)	0.8
Burial Depth (to the center of the cable)	1.0 m
Circuit Spacing (center to center)	0.30 m

6.5 LV SERVICE CONNECTIONS CIRCUIT BREAKERS

Molded Case Circuit Breakers (MCCB) for indoor or outdoor installation in an enclosure , intended to be used for Service Connections in the Low Voltage System. The Standard Ratings for the Circuit Breakers are (20 , 30 , 40 , 50, 70 , 100 , 125 , 150 , 200 , 250 , 300 , 400 , 500 , 600 , 800 Amps).

The incoming terminals shall be suitable for both copper and aluminum conductors of sizes given for the following different ratings as shown in Table (6).

Table (6)

MCCB Rating (Amps)	Max size of conductors suitable for the incoming terminals
20 ,30 , 40 ,50 , 70 ,100 ,125, 150	Copper conductor up to 35mm ²
200 ,250	Copper conductor up to 120mm ²
300 , 400 , 500 , 600 , 800	copper/aluminum conductor up to 300mm ²



Detailed materials specifications for LV Service Connections Circuit Breakers are referred to SEC Distribution Materials Specification No. (37-SDMS-01, Rev.03) with its latest updates.

6.6 KWH METERS

Electro-mechanical and Electronic Kilo-Watt-Hour (KWH) meters, intended to be used for revenue metering in the system.

The KWH meters used by SEC are classified as given below in Table (7) :

Table (7)

Meter Type	Meter CB Rating (A)
Whole Current Meter	20 , 30 , 40 , 50 , 70 , 100 , 125, 150
CT Operated Meter	200 A ,250 , 300 A , 400 A , 500 A , 600 A , 800

Detailed materials specifications for Kilo-Watt-Hour Meters are referred to SEC Distribution Materials Specification No. (40-SDMS-01 Rev .02) , No. (40-SDMS-02A Rev .07) and No.(40-SDMS-02B Rev .06) with its latest updates.

6.7 METERS BOXES

Fiberglass reinforced polyester boxes to be used for Kilo Watt Hour (KWH) meters in the distribution system.

The meter boxes used by SEC are classified as given below in Table (8) :

Table (8)

Meter Box Type	No. & Type of Meters	Meter CB Rating
Single meter box	one whole current meter	rated up to 150 A
Double meter box	two whole current meters	each rated up to 150 A
Quadruple meter box	four whole current meters	each rated up to 150 A
200/250 A CT meter box	one CT meter	rated 200/250 A
300/400 A CT meter box	one CT meter	rated 300/400 A
500/600 A CT meter box	one CT meter	rated 500/600 A
800 A Remote meter box	one CT meter	rated 800 A

	الشركة السعودية للكهرباء Saudi Electricity Company	DISTRIBUTION PLANNING STANDARD DPS-02
	DISTRIBUTION PLANNING STANDARD Design Guideline Of Underground Low Voltage Network To Supply Customers	ISSUE DATE: September, 2015
	REVISION 02	
		Page 13 of 78

The incoming terminals shall be suitable for sizes of LV Cables given for the following different Meter Box types as shown in Table (9) below.

Table (9)

Meter Box Type	Max size of LV Cables suitable for the incoming terminals	Box Rating
Single meter box	two cables of sizes up to 4x70 mm ² AL	200 Amps
Double meter box	two cables of sizes up to 4x185 mm ² AL	300 Amps
Quadruple meter box	two cables of sizes up to 4x300 mm ² AL	400 Amps
200/250 A CT meter box	two cables of sizes up to one 4 x 300 mm ² + one 4 x 185 mm ²	400 Amps
300/400 A CT meter box	two back to back cables of sizes up to one 4 x 300 mm ² + one 4 x 185 mm ²	400 Amps
500/600 A CT meter box	two back to back cables of sizes up to 4 x 300 mm ²	600 Amps
800 A Remote meter box	two cables of sizes up to 4 x 300 mm ²	800 Amps

Detailed materials specifications for Meter Boxes are referred to SEC Distribution Materials Specification No. (42-SDMS-01, Rev.04) , No. (42-SDMS-02, Rev.00) and No. (42-SDMS-03, Rev.00) with its latest updates.

7.0 LOCATIONS OF LV DISTRIBUTION PILLARS

The following points shall be considered for installation of distribution pillars :

- a) Shall be installed at the load center as far as geographically possible to minimize service cable length.
- b) Shall be installed between two plots to avoid future relocation.
- c) May be placed at the inside of a sidewalk close to customer premises.
- d) Should be easily accessible from the front of consumer's boundary without any obstruction.
- e) Shall not be located on the top of sewerage system.

Detailed Construction Specifications for Locations of LV Distribution Pillars are referred to SEC Distribution Construction Standard No. (SDCS-02, PART 4 , Rev.00) with its latest updates.

	الشركة السعودية للكهرباء Saudi Electricity Company	DISTRIBUTION PLANNING STANDARD DPS-02
	DISTRIBUTION PLANNING STANDARD Design Guideline Of Underground Low Voltage Network To Supply Customers	ISSUE DATE: September, 2015
	REVISION 02	
		Page 14 of 78

8.0 LOCATIONS OF DISTRIBUTION SUBSTATIONS SITES

Substations can be installed at a number of locations such as followings :

- Insets of Customers lots
- Municipality land, e.g. open spaces , Schools , mosques , Car Parking , Gardens , Public Places etc.

For area electrification SEC will negotiate with the developer or the local Municipality for the land and locations required for substations.

When preliminary design of a residential area has been completed and optimum substation sites required have been determined it is essential to indicate the same to the area developer which may be private owner, Municipality, or Ministry of Housing for the provision of the easements for SEC facilities including substations and ring main units.

- The preferred substation type will be the unit substation and will be installed in all cases except where extensible HV switch gear is required.
- The preferred locations are on the services area and Municipality land, e.g., open spaces, schools, mosques, car parks, etc.
- The substation should be located on asphalted or leveled roads so that the medium voltage cables can be laid without any hindrance or difficulty.
- The substation shall be installed at the load center as far as geographically possible to minimize LV cables length.

Size of Inset for Distribution Substation :

Size of Inset for Distribution Substation depends on the different rating of this Distribution Substation as shown below in Table (10).

Table (10)

Distribution Substations Rating (KVA)	Site Dimensions (m²)
300 , 500 , 1000	4 x 2 meters
1500	4.5 x 2 meters

In order to accommodate all the different ratings of Distribution Substations i.e. 300, 500, 1000 and 1500 KVA of package substation or unit substation, a total space of 4.5 x 2 meters is required. This is to guarantee that it can handle the size of 1500 KVA substation if required in future.

Detailed Dimensions and Construction Specifications for Location and Size of Substation Sites should be according to SEC Distribution Construction Standard No. (SDCS-02, PART 1 , Rev.00) with its latest updates.



ISSUE DATE:	REVISION
September, 2015	02
	Page 15 of 78

9.0 UNDERGROUND LOW VOLTAGE NETWORK CONFIGURATION

There are three standard connection configuration types for customer connections in Low Voltage Underground Network depends on customers demand loads as following :

(a) Connection through Distribution Pillar

This type of connection is shown in Figure (1) and Figure (2) , For this condition, cable 300 mm^2 AL/XLPE is used from substation to distribution Pillar, and cables 185mm^2 AL/XLPE, 70 mm^2 AL/XLPE are used from distribution Pillar to the customer meter/meters box. (**Common Configuration**).

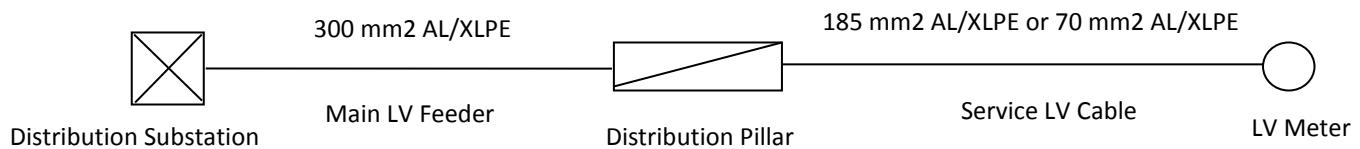


Figure (1)

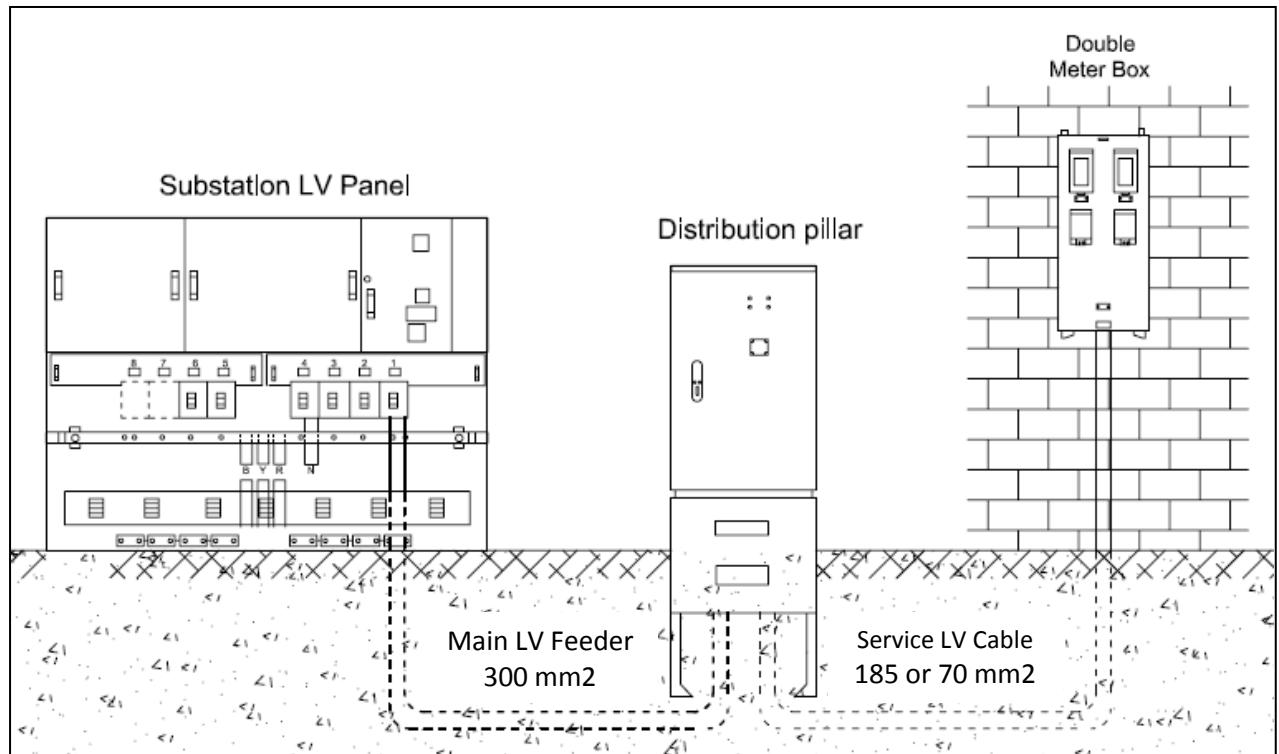


Figure (2)



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Saudi Electricity Company

**DISTRIBUTION PLANNING STANDARD
Design Guideline Of Underground Low
Voltage Network To Supply Customers**

DISTRIBUTION PLANNING STANDARD
DPS-02

ISSUE DATE:

September, 2015

REVISION

02

Page 16 of 78

(b) Direct Connection

This type of connection is shown in Figure (3) and Figure (4) , For this condition, cable 300 mm² AL/XLPE is used directly from substation to the customer meter/meters box. (**Heavy Load Lots only**).

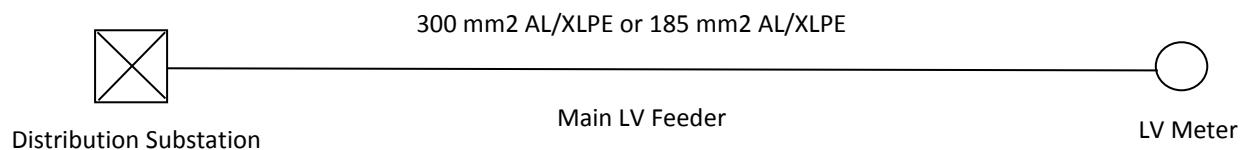


Figure (3)

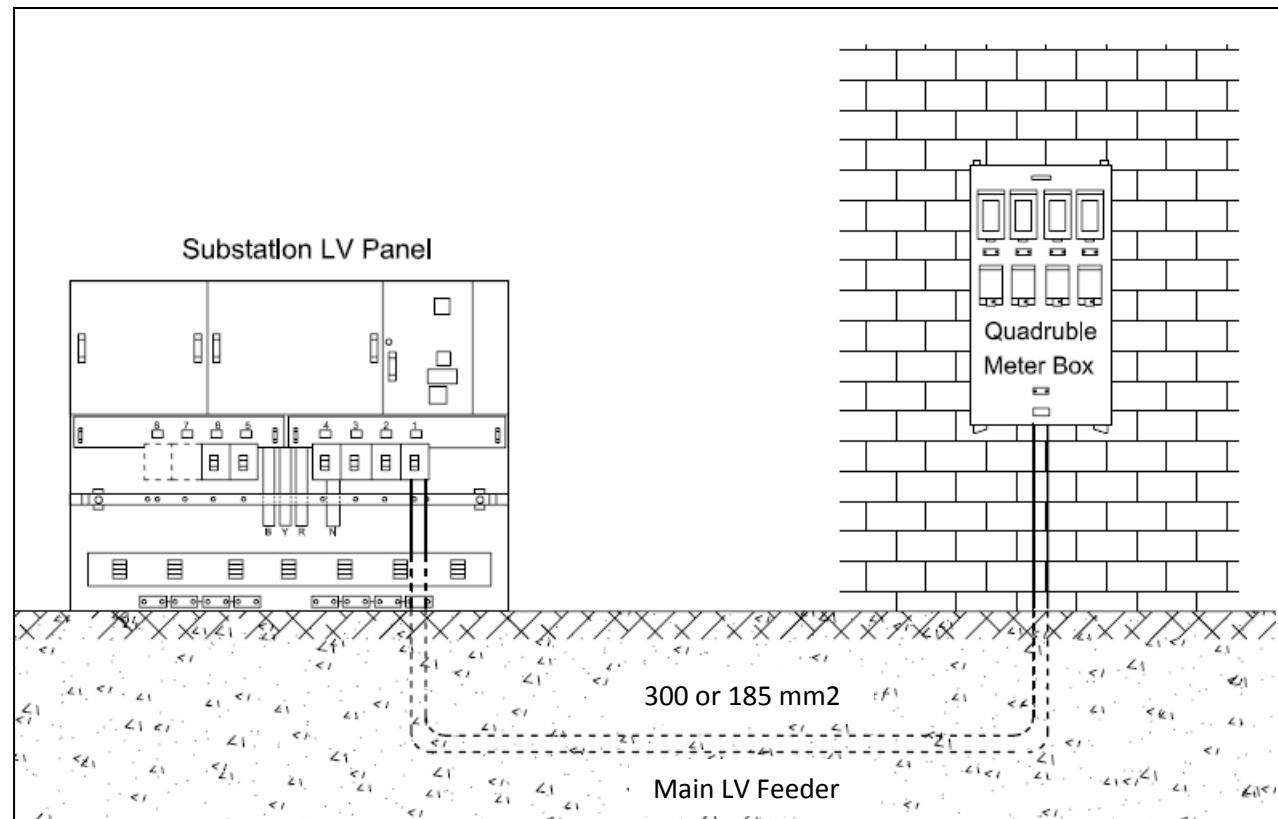


Figure (4)



الشركة السعودية للكهرباء

Saudi Electricity Company

**DISTRIBUTION PLANNING STANDARD
Design Guideline Of Underground Low
Voltage Network To Supply Customers**

DISTRIBUTION PLANNING STANDARD
DPS-02

ISSUE DATE:

September, 2015

REVISION

02

Page 17 of 78

(c) Connection through Two Distribution Pillars

In the areas where load of customers is low , the outgoing of the distribution pillar can be used to feed the second distribution pillar to provide connection to more consumers. This type of connection is shown in Figure (5) and Figure (6) , For this condition, cable 300 mm^2 AL/XLPE is used from substation to the first distribution Pillar, and cables 300 mm^2 AL/XLPE or 185 mm^2 AL/XLPE are used from the first distribution Pillar to the second distribution Pillar and cables 185 mm^2 AL/XLPE or 70 mm^2 AL/XLPE are used from distribution Pillar to the customer meter/meters box. (**Light Load Lots only**).

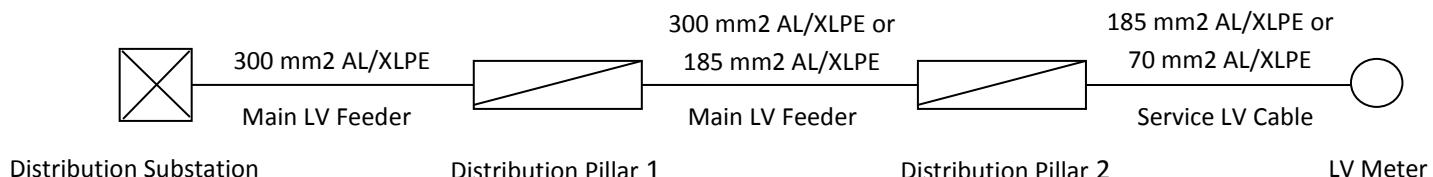


Figure (5)

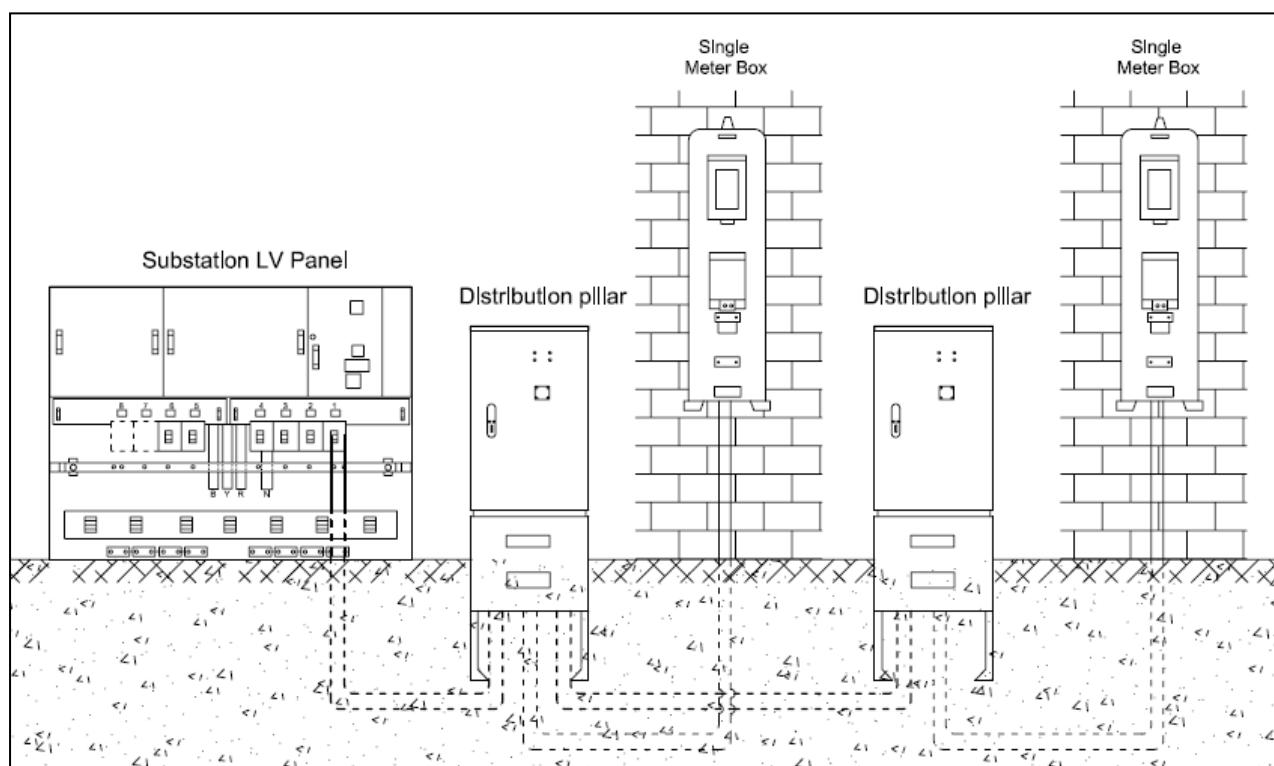


Figure (6)

	الشركة السعودية للكهرباء Saudi Electricity Company	DISTRIBUTION PLANNING STANDARD DPS-02
	DISTRIBUTION PLANNING STANDARD Design Guideline Of Underground Low Voltage Network To Supply Customers	ISSUE DATE: September, 2015
	REVISION 02	
		Page 18 of 78

10.0 PRINCIPLES OF DESIGN

The Low voltage networks (also called secondary network) are connected at one end and have no facility of back-feeding.

The following objectives should be achieved in the design of low voltage networks taking into account all prevailing safety and reliability standards :

- Satisfaction of Customer Coincident Demand Load.
- Equipment ratings are not exceeded.
 - ✓ The LV cable(s) shall not be loaded more than 80% of its rated capacity.
 - ✓ The Distribution Pillars shall not be loaded more than 80% of its rated capacity.
 - ✓ The loading of the Distribution Transformers shall not exceed 80% of full load rated capacity (KVA).
- Voltage Drops are within allowable limits:
 - ✓ Service Voltage at customer supply interface point must be within $\pm 5\%$ of nominal voltage.
 - ✓ Voltage Drop at customer supply interface point shall not exceed 5% of nominal voltage.
- The design is the most economical (Low Cost) for the projected load and layout.

10.1 CUSTOMER'S COINCIDENT DEMAND LOAD

Estimation of Customer's Coincident Demand Load should be referred to SEC Distribution Planning Standards No. (DPS-01, Rev.02) named (Estimation of Customer Load Guideline) with its latest updates.

10.2 COINCIDENT DEMAND LOAD ON LV NETOWRK ELEMENTS

The following Formula should be used to calculate the Coincident Demand Load (CDL) on any LV Network Element for the group of all KWH Meters supplied by that LV Network Element as below.



ISSUE DATE:	REVISION
September, 2015	02
	Page 19 of 78

$$CDL_{on\ Network} = \left(\sum_{i=1}^N CBR_i \times DF_i \right) \times CF(N)$$

Where :

N = Number of all KWH Meters supplied by that LV Network Element (SS , DP , LV Cable).

CBR_i = Circuit Breaker Rating in (Amp) for the Individual KWH Meter no. (i).

DF_i = Demand Factor for the Individual KWH Meter no. (i) which should be determined according to the utilization nature of the concerned Individual unit no. (i) in customer's building and referring to SEC Distribution Planning Standards No.(DPS-01, Rev. 02) titled (Estimation of Customer Load Guideline) with its latest updates.

$CF(N)$ = Coincident Factor for the group of all KWH Meters supplied by that LV Network Element (SS , DP , LV Cable) which should be determined according to Number of these KWH Meters (N) and referring to SEC Distribution Planning Standards No.(DPS-01, Rev. 02) titled (Estimation of Customer Load Guideline) with its latest updates. It can be calculated by the following equation :

$$CF(N) = \frac{\left(0.67 + \frac{0.33}{\sqrt{N}} \right)}{1.25}$$

$$\text{For } N = 1 \Rightarrow CF(N) = 1$$

10.3 EQUIPMENT CHARACTERISTICS (FULL RATING & FIRM CAPACITY)

The loading percentage on all LV Equipments shall not exceed its Firm Capacity (80% of its ratings).

- a) **The LV Cables** shall not be loaded more than its Firm Capacity (80% of its rated capacity) given in Table (12) below.



Table (11)

LV Cable Size	Rating (Amps)	Rating (KVA) for Different Voltages (V)		
		Standard Nominal Voltages		
		400	380	220
4 X 300 mm ² AL	310	215	204	118
4 X 185 mm ² AL	230	159	151	88
4 X 70 mm ² AL	135	94	89	51

Table (12)

LV Cable Size	Firm Capacity (Amps)	Firm Capacity (KVA) for Different Voltages (V)		
		Standard Nominal Voltages		
		400	380	220
4 X 300 mm ² AL	248	172	163	95
4 X 185 mm ² AL	184	127	121	70
4 X 70 mm ² AL	108	75	71	41

$$\text{Firm Capacity} = 80\% \times \text{Rating}$$

- b) The Distribution Pillars shall not be loaded more than its Firm Capacity (80% of its rated capacity) given below in Table (14).

Table (13)

Distribution Pillar	Rating (Amps)	Rating (KVA) for Different Voltages (V)		
		Standard Nominal Voltages		
		400	380	220
	400	277	263	152

Table (14)

Distribution Pillar	Firm Capacity (Amps)	Firm Capacity (KVA) for Different Voltages (V)		
		Standard Nominal Voltages		
		400	380	220
	320	222	211	122

$$\text{Firm Capacity} = 80\% \times \text{Rating}$$

	الشركة السعودية للكهرباء Saudi Electricity Company	DISTRIBUTION PLANNING STANDARD DPS-02	
	DISTRIBUTION PLANNING STANDARD Design Guideline Of Underground Low Voltage Network To Supply Customers	ISSUE DATE:	REVISION
	September, 2015	02	
		Page 21 of 78	

- c) **The Distribution Substations** shall not be loaded more than its Firm Capacity (80% of its rated capacity) given in Table (15) below.

Table (15)

Distribution Substation	Rating (KVA)	Firm Capacity (KVA)
300 KVA	300	240
500 KVA	500	400
1000 KVA	1000	800
1500 KVA	1500	1200

$$\text{Firm Capacity} = 80\% \times \text{Rating}$$

10.4 VOLTAGE DROP CALCULATION

For a particular supply voltage the voltage drop from the supply point to the customer interface depends on various factors such as customer demand, length and size of cable, and power factor. Formula for voltage drop is provided below :

$$VD\% = \frac{100 \times KVA \times (R \times \cos \varphi + X \times \sin \varphi) \times L}{V^2}$$

Where:

$VD\%$ = Voltage drop percentage on the cable in (%)

KVA = Three phase power in (KVA)

= Coincident Demand Load (CDL) on the cable.

R = Resistance of conductor in ohm per kilometer in (Ω/km)

X = Inductive reactance of conductor in ohm per kilometer in (Ω/km)

φ = Power factor angle of the supply

V = Three phase supply nominal voltage in (volts)

L = Length of the cable in (meters)

The formula has reduced to a simple constant K equivalent to the product of KVA and length of cable in meter at power factor of 0.85 lagging. For various values of KVA-meter the voltage drop can be calculated by dividing it with this constant K .

$$K = \frac{V^2}{100 \times (R \times \cos \varphi + X \times \sin \varphi)}$$



The value of the **K** constant changes with the supply voltage, power factor and size and type of cable, due to the change of resistance and inductance. The calculations of **K** values are shown in Table (16) below.

Table (16)

Cable Size	V	R	X	cosφ	sinφ	K
mm ²	Volts	Ω/km	Ω/km			V ² .km/Ω
300	400	0.13	0.09	0.85	0.527	10132
300	380	0.13	0.09	0.85	0.527	9144
300	220	0.13	0.09	0.85	0.527	3065
185	400	0.211	0.091	0.85	0.527	7040
185	380	0.211	0.091	0.85	0.527	6353
185	220	0.211	0.091	0.85	0.527	2129
70	400	0.568	0.095	0.85	0.527	3003
70	380	0.568	0.095	0.85	0.527	2710
70	220	0.568	0.095	0.85	0.527	908

The values of **K** constant to be used for various standard LV cables are provided hereunder in table (17):

Table (17)

LV Cable Size	Constant K		
	Standard Nominal Voltages		
	400 V	380 V	220 V
4 x 300 mm ² (AL)	10132	9144	3065
4 x 185 mm ² (AL)	7040	6353	2129
4 x 70 mm ² (AL)	3003	2710	908

The simplified formula for Voltage Drop calculation is :

$$VD\% = \frac{KVA \times L}{K}$$

Where:

VD% = Voltage drop percentage on the cable in (%)

KVA = Three phase power in (KVA)

= Coincident Demand Load (CDL) on the cable

L = Length of the cable in (meters)

K = The constant in (V².km/Ω) according to Table (17) above

	الشركة السعودية للكهرباء Saudi Electricity Company	DISTRIBUTION PLANNING STANDARD DPS-02
	DISTRIBUTION PLANNING STANDARD Design Guideline Of Underground Low Voltage Network To Supply Customers	ISSUE DATE: September, 2015
	REVISION 02	
		Page 23 of 78

Note: Above Voltage Drop calculations formula are based on balanced 3-Phase system.

Example :

Max Lengths (m) can be achieved within (5%) Voltage Drop with Loading up to Firm Capacity (KVA) for Different Nominal Voltages (V) for Different Sizes of LV Cables are calculated using the above formula, as shown in Table (18) below.

Table (18)

LV Cable Size	Max Length (m) within (5%) Voltage Drop with Loading up to Firm Capacity (KVA) for Different Voltages (V)		
	400 V	380 V	220 V
4 X 300 mm² AL	295	280	162
4 X 185 mm² AL	276	262	152
4 X 70 mm² AL	201	191	110

Voltage Drop Allocation :

The Utility voltage drop allocations listed in Table (19) shall be used as guideline voltage drops over the power system components supplying a low voltage customer to minimize lengths of Service Cables as possible.

Table (19)

LV Network Component	Voltage Drop %
LV Main Feeder	3.5
Service Cable	1.5
Total Voltage Drop	5.0

Example :

Max Lengths (m) can be achieved within (5%) Voltage Drop with Loading up to Firm Capacity (KVA) on Main LV Feeder (300 mm^2) & with (30 A) LV Meter (0.6 DF) on Service Cable (70 mm^2) for Different Nominal Voltages (V) are calculated by using the Voltage Drop calculations formula and by applying the voltage drop allocations values listed in Table (19), as shown in Table (20) below



Table (20)

Voltage Drop (%) =	3.5	1.5	5
LV Cable Size	300 mm ²	70 mm ²	Total Length (m)
Max Length (m) within (5%) Voltage Drop with Loading up to Firm Capacity (KVA) on LV Main Feeder (300 mm ²) & with (30 A) Meter (0.6 DF) on Service Cable (70 mm ²) for Different Voltages (V)	400 V	206	361
	380 V	196	343
	220 V	114	199

Factors Affecting the Voltage Drop :

Following are the other factors affecting the Voltage Drop :

- a) The representation of the 3 phase, phase-phase and phase-neutral loads will be a single phase system derived from the assumption that the load is balanced. It is known that the above is an over simplification and that site measurements show that one or two phases are more heavily loaded. This real situation shows that a correction factor is required. This is known as the unequal loading in the phase.
- b) In the SEC system, loads are mainly phase-phase with a smaller superimposed phase-neutral load distributed over the 3 phases. The phase-neutral loads give rise to the unequal loading in the phase.
- c) Neutral current produces a voltage drop which has to be added to the phase conductor voltage drop. The value of this neutral current which will flow is different throughout the length of the conductor due to the vectorial addition. A correction factor is required to allow for neutral current voltage drop.
- d) The reactive impedance of the cable produces a voltage drop which is dependent on the power factor of the loads. Power factor of 0.85 has been built into the calculation above.
- e) The resistance value of aluminum varies with temperature. In a distributor supplying a number of customers the current is not a constant value throughout the conductor and the temperature of the cable core will change along the length of the conductor.
- f) The rating of the cables used is very dependent upon the cyclic nature of the load. For the period when high loads are expected on the cable a daily load factor of less than one has been observed. Load factors lower than 0.84 allow considerable increase in the amps/phase which the cable can safely carry. However there is a change over point where the voltage drop along the distributor is reached before the thermal limit is reached and there is no benefit

	الشركة السعودية للكهرباء Saudi Electricity Company	DISTRIBUTION PLANNING STANDARD DPS-02
	DISTRIBUTION PLANNING STANDARD Design Guideline Of Underground Low Voltage Network To Supply Customers	ISSUE DATE: September, 2015
	REVISION 02	
		Page 25 of 78

from an increase in the permitted amps which a cable can carry beyond those quoted

- g) Loads are assumed to be either applied as point or end loads or can be assumed to be evenly distributed and therefore acting as end load applied at the mid-point of the distributor length. Loads per villa are calculated in accordance with the tabulation based on Municipality Building Permit. The tabulation has been correlated to the Ministry of Electricity Rules.
- h) The currents flowing in each branch of the distributor required to be diversified in accordance with the Diversity Factors for Systems which have been derived from system measurements and observations.

10.5 GENERAL PRINCIPLES OF DESIGN

1. Design of any LV network element (Substation , Main LV Feeder , Distribution Pillar , Service Connection Cable) should be based on the Coincident Demand Load (CDL) of all customers KWH Meters supplied from this element LV network element.
2. To maintain the Loading percentage on any LV network element (Substation , Main LV Feeder , Distribution Pillar , Service Connection Cable) within the Firm Capacity (80 % of Rating) of that LV network element.
3. To maintain the Total Voltage Drop percentage on the whole LV network (Main LV Feeder + Service Connection Cable) from the Substation to the customer's location within the Voltage Drop limits (5 % of Nominal Voltage).
4. The LV network design should be the most economical (Lowest Cost) as possible to supply the projected customer's load.
5. The suitable size of the cable to supply the customer should be selected according to the Coincident Demand Load (CDL) of that customer and should be suitable to satisfy that customer's CDL is not greater than the Firm Capacity (80 % of Rating) of that Cable.
6. The suitable connection configuration type to supply the customer should be selected according to the Coincident Demand Load (CDL) of that customer.
7. Connection configuration type with Two Distribution Pillars in one main LV feeder can be used only in light load density area.
8. CDL on the SS should be not greater than SS's Firm Capacity (i.e. not exceeding 80 % of SS's rating).

$$CDL (KVA)_{on\ SS} = CDL \text{ for all } N \text{ Meters supplied from SS}$$

$$\text{Loading \%}_{on\ SS} = \frac{CDL (KVA)_{on\ SS}}{\text{Rating}_{SS}} \times 100$$

	الشركة السعودية للكهرباء Saudi Electricity Company	DISTRIBUTION PLANNING STANDARD DPS-02
	DISTRIBUTION PLANNING STANDARD Design Guideline Of Underground Low Voltage Network To Supply Customers	
	ISSUE DATE: September, 2015	REVISION 02
		Page 26 of 78

9. CDL on the DP should be not greater than DP's Firm Capacity (i.e. not exceeding 80 % of DP's rating).

$$CDL_{on\ DP} = CDL \text{ for all } N \text{ Meters supplied from DP}$$

$$\text{Loading \%}_{on\ DP} = \frac{CDL_{on\ DP}}{\text{Rating}_{DP}} \times 100$$

10. CDL on the LV Main Feeder should be not greater than LV Main Feeder's Firm Capacity (i.e. not exceeding 80 % of LV Main Feeder's rating).

$$CDL_{on\ Main\ Feeder} = CDL \text{ for all } N \text{ Meters supplied from Main Feeder}$$

$$\text{Loading \%}_{on\ Main\ Feeder} = \frac{CDL_{on\ Main\ Feeder}}{\text{Rating}_{Main\ Feeder}} \times 100$$

11. CDL on the Service Cable should be not greater Service Cable's Firm Capacity (i.e. not exceeding 80 % of Service Cable's rating).

$$CDL_{on\ Service\ Cable} = CDL \text{ for all } N \text{ Meters supplied from Service Cable}$$

$$\text{Loading \%}_{on\ Service\ Cable} = \frac{CDL_{on\ Service\ Cable}}{\text{Rating}_{Service\ Cable}} \times 100$$

12. CDL on the Direct Feeder should be not greater than Direct Feeder's Firm Capacity (i.e. not exceeding 80 % of Direct Feeder's rating).

$$CDL_{on\ Direct\ Feeder} = CDL \text{ for all } N \text{ Meters supplied from Direct Feeder}$$

$$\text{Loading \%}_{on\ Direct\ Feeder} = \frac{CDL_{on\ Direct\ Feeder}}{\text{Rating}_{Direct\ Feeder}} \times 100$$

13. Total VD% from SS to customer's location should be not greater than voltage drop limit (i.e. not exceeding 5 %).

$$VD\ \%_{Service\ Cable} = \frac{CDL(KVA)_{on\ Service\ Cable} \times L_{Service\ Cable}}{K_{Service\ Cable}}$$

$$VD\ \%_{Main\ Feeder} = \frac{CDL(KVA)_{on\ Main\ Feeder} \times L_{Main\ Feeder}}{K_{Main\ Feeder}}$$

$$VD\ \%_{Direct\ Feeder} = \frac{CDL(KVA)_{on\ Direct\ Feeder} \times L_{Direct\ Feeder}}{K_{Direct\ Feeder}}$$

$$VD\ \%_{from\ SS\ to\ Customer}^{Total} = VD\ \%_{Main\ Feeder} + VD\ \%_{Service\ Cable}$$

$$VD\ \%_{from\ SS\ to\ Customer}^{Total} = VD\ \%_{Direct\ Feeder}$$

14. Always try first to supply customer's CDL from any existing nearby DP's (one by one) with priority for the nearest as possible based on the criteria (Loading % , Voltage Drop %) before planning to install new DP.

15. Always try first to supply customer's CDL from any existing nearby SS's (one by one) with priority for the nearest as possible based on the criteria (Loading % , Voltage Drop %) before planning to install new SS.

	الشركة السعودية للكهرباء Saudi Electricity Company	DISTRIBUTION PLANNING STANDARD DPS-02
	DISTRIBUTION PLANNING STANDARD Design Guideline Of Underground Low Voltage Network To Supply Customers	ISSUE DATE: September, 2015
	REVISION 02	
		Page 27 of 78

16. To supply customer's CDL from any existing DP , first check for availability of any vacant outgoing in that DP.
17. To supply customer's CDL from any existing SS , first check for availability of any vacant outgoing in that SS.
18. Install the new SS in the center of loads area (including : concerned new customer , existing others nearby supply requests , nearby under constructions buildings , empty lots) as possible.
19. Install a new DP near to customers' lots in the center of loads (i.e. in the middle between customers' lots) as possible.
20. Select the shortest geographic route for the LV Main Feeder (300 mm² cable) from SS to the new DP (as possible).
21. Select the shortest geographic route for the service cable from the new DP to customer's location (as possible).
22. Select the shortest geographic route for the Direct Feeder from SS to the customer's location (as possible).
23. Always try to avoid crossing the streets when you design the route of any LV cable as possible as you can.
24. It is not allowed to cross any street with width more than 36 meters for any LV cable rout.
25. CB/Fuse rating of the outgoing from any supply source (Substation , Distribution Pillar) should be not lesser than the largest CB rating of all KWH Meters supplied from this outgoing CB/Fuse. Same is valid for any two CBs/Fuses outgoings supply customers.
26. CB/Fuse rating of the outgoing from any supply source (Substation , Distribution Pillar) should be not lesser than the Coincident Demand Load (CDL) of all customers KWH Meters supplied from this outgoing CB/Fuse. Same is valid for any two CBs/Fuses outgoings supply customers.
27. Size (KVA rating) of the new SS should be selected based on the need of the neighbor area (including : concerned new customer , existing others nearby supply requests , nearby under constructions buildings , existing empty lots) and it should be as minimum as sufficient to meet their total Coincident Demand Load (CDL).
28. If multi substations are required to supply a customer , select the no. of the required substations and their ratings from the available SEC standard (300, 500, 1000, 1500 KVA) where the summation of substations ratings should provide minimum sufficient total capacity to meet the calculated Coincident Demand Load (CDL) of the customer with minimum no. of substations.

	الشركة السعودية للكهرباء Saudi Electricity Company	DISTRIBUTION PLANNING STANDARD DPS-02
	DISTRIBUTION PLANNING STANDARD Design Guideline Of Underground Low Voltage Network To Supply Customers	ISSUE DATE: September, 2015
	REVISION 02	
		Page 28 of 78

29. For supplying new customers, it is preferred to use the substation with (500 KVA or 1000 KVA) rating. This is to maintain a possibility for reinforcement of these substations (1000 KVA & 500 KVA) by replacing them with 1500 KVA substation without the need to install a new substation.
30. The substation with 300 KVA rating can be used in light load density area and also for remote dedicated customers with light loads.
31. No. of Meter Boxes and their sizes required to handle the KWH Meters required to supply a customer should be as minimum as sufficient with minimum no. of Meter Boxes. i.e. always use larger size of Meter Box to handle more possible KWH Meters in one box instead to use multi smaller size of Meter Boxes for same no. of KWH Meters.
32. To supply a new customer's CDL from an existing DP , evaluation for the criteria (Loading % , Voltage Drop %) should be based on the Coincident Demand Load (CDL) of all customers KWH Meters (concerned new customer + existing customers) supplied from this DP. Only in case that the measured Maximum Demand (MD) on that DP is greater than CDL of existing customers , so the CDL of the concerned new customer should be corrected by the scaling of MD on DP as shown in the following equation :

$$CDL_{\text{New Customer}} = \frac{MD_{\text{on DP for Existing Customers}}}{CDL_{\text{on DP for Existing Customers}}} \times CDL_{\text{New Customer}}$$

Then evaluating for the criteria (Loading % , Voltage Drop %) should be based on summation of MD on DP and the corrected CDL of concerned new customer.

33. To supply a new customer's CDL from an existing SS , evaluation for the criteria (Loading % , Voltage Drop %) should be based on the Coincident Demand Load (CDL) of all customers KWH Meters (concerned new customer + existing customers) supplied from this SS. Only in case that the measured Maximum Demand (MD) on that SS is greater than CDL of existing customers , so the CDL of the concerned new customer should be corrected by the scaling of MD on SS as shown in the following equation :

$$CDL_{\text{New Customer}} = \frac{MD_{\text{on SS for Existing Customers}}}{CDL_{\text{on SS for Existing Customers}}} \times CDL_{\text{New Customer}}$$

Then evaluation for the criteria (Loading % , Voltage Drop %) should be based on summation of MD on SS and the corrected CDL of concerned new customer.

	الشركة السعودية للكهرباء Saudi Electricity Company	DISTRIBUTION PLANNING STANDARD DPS-02
	DISTRIBUTION PLANNING STANDARD Design Guideline Of Underground Low Voltage Network To Supply Customers	ISSUE DATE: September, 2015
		REVISION 02
		Page 29 of 78

11.0 STEP BY STEP DESIGN PROCEDURES

1. Connected Load (CL) in (KVA) for each Individual unit in customer's building should be estimated, unit by unit, referring to SEC Distribution Planning Standards No.(DPS-01, Rev. 02) titled (Estimation Of Customer Load Guideline) with its latest updates.
2. Individual Circuit Breaker Rating (CBR) in (Amp) for the Individual KWH Meter for each Individual unit in customer's building should be determined according to the estimated connected load (CL) of that Individual unit and referring to SEC Distribution Planning Standards No.(DPS-01, Rev. 02) titled (Estimation of Customer Load Guideline) with its latest updates.
3. Number of Individual KWH Meters (N) required for the customer's building should be determined according to number of Individual units in customer's building and referring to SEC Customer Services Manual with its latest updates.
4. Calculate the Coincident Demand Load (CDL) in (Amp) for the group of all KWH Meters of the customer's building as follows :

$$CDL = \left(\sum_{i=1}^N CBR_i \times DF_i \right) \times CF(N)$$

Where :

N = Number of Individual KWH Meters required for the customer's building.

CBR_i = Circuit Breaker Rating in (Amp) for the Individual KWH Meter no. (i).

DF_i = Demand Factor for the Individual KWH Meter no. (i) which should be determined according to the utilization nature of the concerned Individual unit no. (i) in customer's building and referring to SEC Distribution Planning Standards No.(DPS-01, Rev. 02) titled (Estimation of Customer Load Guideline) with its latest updates.

$CF(N)$ = Coincident Factor for the group of all KWH Meters of the customer's building which should be determined according to Number of these KWH Meters (N) and referring to SEC Distribution Planning Standards No.(DPS-01, Rev. 02) titled (Estimation of Customer Load Guideline) with its latest updates.

$$CF(N) = \frac{\left(0.67 + \frac{0.33}{\sqrt{N}} \right)}{1.25}$$

$$\text{For } N = 1 \Rightarrow CF(N) = 1$$

	الشركة السعودية للكهرباء Saudi Electricity Company	DISTRIBUTION PLANNING STANDARD DPS-02
	DISTRIBUTION PLANNING STANDARD Design Guideline Of Underground Low Voltage Network To Supply Customers	ISSUE DATE: September, 2015
		REVISION 02
		Page 30 of 78

Note :

For a group of (N) KWH Meters in the customer's building where all of them have same Circuit Breaker Rating (CBR) in (Amp) and same Demand Factor (DF), the equation to calculate the Coincident Demand Load (CDL) in (Amp) for this group of KWH Meters could be simplified as follows :

$$CDL = N \times CBR \times DF \times CF(N)$$

Note :

For a group of (N) KWH Meters in the customer's building where any one of them has different Circuit Breaker Rating (CBR) in (Amp), the equation to calculate the Coincident Demand Load (CDL) in (Amp) for this group of KWH Meters will be as follows :

$$CDL = \left[CBR_{\substack{\text{Largest} \\ \text{Meter}}} \times DF_{\substack{\text{Largest} \\ \text{Meter}}} \right] + \left[\left(\sum_{i=1}^{N-1} CBR_i \times DF_i \right) \times CF(N-1) \right]$$

5. Calculate the Coincident Demand Load (CDL) in (KVA) of the customer's building from the calculated Coincident Demand Load (CDL) in (Amp) as follows :

$$CDL_{in\ KVA} = \frac{CDL_{in\ AMP} \times V_{LL} \times \sqrt{3}}{1000}$$

Where :

V_{LL} = Nominal Voltage (line to line) of the LV Network (in volts).

This equation can be simplified as follows :

$$CDL_{in\ KVA} = \frac{CDL_{in\ AMP}}{F_{Conversion}}$$

Where :

$F_{Conversion}$ = Conversion Factor to convert (CDL) from (Amp) to (KVA). Its values for different nominal voltages are shown in the following Table (21) below.

Table (21)

Conversion Factor $F_{Conversion}$	Standard Nominal Voltages (V)		
	400	380	220
	1.443	1.519	2.624



6. Based on the calculated Coincident Demand Load (CDL) in (Amp) of the customer's building , select the suitable connection configuration type to supply this Coincident Demand Load (CDL) as shown in Table (22) hereunder. the suitable connection configuration type includes :

- Size of cable to customer.
- No. of cables to customer required.
- Suitable supply source : Direct Feeder from Substation (SS) or Service Connection through Distribution Pillar (DP).
- No. of outgoing required.

Table (22)

Coincident Demand Load (Amps)		Coincident Demand Load (KVA) for Different Voltages (V)						Supply Source	No. of Outgoing Fuses / MCCBs	No. of LV Cables to Customer	Size of LV Cables to Customer	Main LV Feeder									
		Standard Nominal Voltages (V)												No. of Cables to DP	Cable Size						
		From	To	From	To	From	To														
1	108	1	75	1	71	1	41	DP	1	1	70 mm ²	1	300 mm ²								
109	184	76	127	72	121	42	70	DP	1	1	185 mm ²	1	300 mm ²								
185	216	128	150	122	142	70	82	DP	2	2	70 mm ²	1	300 mm ²								
217	248	150	172	143	163	83	95	DP	2	2	185 mm ²	1	300 mm ²								
1	184	1	127	1	121	1	70	SS	1	1	185 mm ²	Direct Feeder									
185	248	128	172	122	163	70	95	SS	1	1	300 mm ²	Direct Feeder									
249	368	173	255	164	242	95	140	SS	2	2	185 mm ²	Direct Feeder									
369	496	256	344	243	326	141	189	SS	2	2	300 mm ²	Direct Feeder									

7. If the suitable connection configuration type is Service Connection through Distribution Pillar (DP) , go to the next step.
8. First try to supply customer's CDL from existing nearby DP by using the following steps :
- a. Select the nearest existing DP to the customer's location (as possible).
 - b. Calculate CDL on the DP including of all customers KWH Meters (concerned new customer + existing customers) supplied from this DP.
 - c. CDL on the DP should be not greater than DP's Firm Capacity (i.e. not exceeding 80 % of DP's rating).
 - d. Calculate CDL on the LV Main Feeder (300 mm² cable) from SS to DP including of all customers KWH Meters (concerned new customer + existing customers) supplied from this LV Main Feeder.
 - e. CDL on the LV Main Feeder should be not greater than LV Main Feeder's Firm Capacity (i.e. not exceeding 80 % of LV Main Feeder's rating).

	الشركة السعودية للكهرباء Saudi Electricity Company	DISTRIBUTION PLANNING STANDARD DPS-02
	DISTRIBUTION PLANNING STANDARD Design Guideline Of Underground Low Voltage Network To Supply Customers	ISSUE DATE: September, 2015
	REVISION 02	
		Page 32 of 78

- f. Calculate CDL on the SS including of all customers KWH Meters (concerned new customer + existing customers) supplied from this SS.
 - g. CDL on the SS should be not greater than SS's Firm Capacity (i.e. not exceeding 80 % of SS's rating).
 - h. Select the shortest geographic route for the service cable from DP to customer's location (as possible).
 - i. Calculate VD% on the LV Main Feeder (300 mm² cable) from SS to DP.
 - j. Calculate VD% on the service cable from DP to customer's location.
 - k. Calculate the Total VD% from SS to customer's location.
 - l. Total VD% from SS to customer's location should be not greater than voltage drop limit (i.e. not exceeding 5 %).
 - m. If customer's CDL cannot be supplied from the selected DP because one of the criteria (Loading % , Voltage Drop %) is not satisfied , Try all others nearby existing DP (one by one) with priority for the nearest and by using same steps in above (from "a" to "l").
9. If customer's CDL cannot be supplied from all nearby existing DP because one of the criteria (Loading % , Voltage Drop %) is not satisfied , go to the next step.
10. Try to supply customer's CDL from existing nearby SS through a new DP by using the following steps :
- a. Select the nearest existing SS to the customer's location (as possible).
 - b. Calculate CDL on the SS including of all customers KWH Meters (concerned new customer + existing customers) supplied from this SS.
 - c. CDL on the SS should be not greater than SS's Firm Capacity (i.e. not exceeding 80 % of SS's rating).
 - d. Design to install a new DP near to customers' lots in the center of loads (i.e. in the middle between customers' lots) as possible.
 - e. Select the shortest geographic route for the new LV Main Feeder (300 mm² cable) from SS to the new DP (as possible).
 - f. Select the shortest geographic route for the service cable from the new DP to customer's location (as possible).
 - g. Calculate VD% on the new LV Main Feeder (300 mm² cable) from SS to the new DP.
 - h. Calculate VD% on the service cable from the new DP to customer's location.
 - i. Calculate the Total VD% from SS to customer's location.
 - j. Total VD% from SS to customer's location should be not greater than voltage drop limit (i.e. not exceed 5 %).
 - k. If customer's CDL cannot be supplied from the selected SS because one of the criteria (Loading % , Voltage Drop %) is not satisfied , Try all others

	<p style="text-align: center;">الشركة السعودية للكهرباء Saudi Electricity Company</p> <p style="text-align: center;">DISTRIBUTION PLANNING STANDARD Design Guideline Of Underground Low Voltage Network To Supply Customers</p>	<p>DISTRIBUTION PLANNING STANDARD DPS-02</p>
	ISSUE DATE: September, 2015	REVISION 02
		Page 33 of 78

nearby existing SS (one by one) with priority for the nearest and by using same steps in above (from "a" to "j").

11. If customer's CDL cannot be supplied from all nearby existing SS because one of the criteria (Loading % , Voltage Drop %) is not satisfied , go to the next step.
12. Design to supply customer's CDL from a new SS through a new DP by using the following steps :
 - a. Design to install a new SS near to customers lots in the center of loads area (including : concerned new customer , existing others nearby supply requests , nearby under constructions buildings , empty lots) as possible.
 - b. Size (KVA rating) of the new SS should be selected based on the need of the neighbor area (including : concerned new customer , existing others nearby supply requests , nearby under constructions buildings , existing empty lots).
 - c. Design to install a new DP near to customers' lots in the center of loads (i.e. in the middle between customers' lots) as possible.
 - d. Select the shortest geographic route for the new LV Main Feeder (300 mm^2 cable) from the new SS to the new DP (as possible).
 - e. Select the shortest geographic route for the service cable from the new DP to customer's location (as possible).
 - f. Calculate VD% on the new LV Main Feeder (300 mm^2 cable) from the new SS to the new DP.
 - g. Calculate VD% on the service cable from the new DP to customer's location.
 - h. Calculate the Total VD% from the new SS to customer's location.
 - i. Total VD% from the new SS to customer's location should be not greater than voltage drop limit (i.e. not exceeding 5 %).
13. If the suitable connection configuration type is Direct Feeder from Substation (SS) , go to the next step.
14. First try to supply customer's CDL from existing nearby SS by using the following steps :
 - a. Select the nearest existing SS to the customer's location (as possible).
 - b. Calculate CDL on the SS including of all customers KWH Meters (concerned new customer + existing customers) supplied from this SS.
 - c. CDL on the SS should be not greater than SS's Firm Capacity (i.e. not exceeding 80 % of SS's rating).
 - d. Select the shortest geographic route for the Direct Feeder from SS to the customer's location (as possible).
 - e. Calculate VD% on the Direct Feeder from SS to the customer's location.
 - f. Total VD% from SS to customer's location should be not greater than voltage drop limit (i.e. not exceeding 5 %).

	الشركة السعودية للكهرباء Saudi Electricity Company	DISTRIBUTION PLANNING STANDARD DPS-02
	DISTRIBUTION PLANNING STANDARD Design Guideline Of Underground Low Voltage Network To Supply Customers	ISSUE DATE: September, 2015
	REVISION 02	
		Page 34 of 78

- g. If customer's CDL cannot be supplied from the selected SS because one of the criteria (Loading % , Voltage Drop %) is not satisfied , Try all others nearby existing SS (one by one) with priority for the nearest and by using same steps in above (from "a" to "f").
15. If customer's CDL cannot be supplied from all nearby existing SS because one of the criteria (Loading % , Voltage Drop %) is not satisfied , go to the next step.
16. Design to supply customer's CDL from a new SS by using the following steps :
- a. Design to install a new SS near to customers lots in the center of loads area (including : concerned new customer , existing others nearby supply requests , nearby under constructions buildings , empty lots) as possible.
 - b. Size (KVA rating) of the new SS should be selected based on the need of the neighbor area (including : concerned new customer , existing others nearby supply requests , nearby under constructions buildings , existing empty lots).
 - c. Select the shortest geographic route for the Direct Feeder from the new SS to the customer's location (as possible).
 - d. Calculate VD% on the Direct Feeder from the new SS to the customer's location.
 - e. Total VD% from the new SS to customer's location should be not greater than voltage drop limit (i.e. not exceeding 5 %).

	الشركة السعودية للكهرباء Saudi Electricity Company	DISTRIBUTION PLANNING STANDARD DPS-02
	DISTRIBUTION PLANNING STANDARD Design Guideline Of Underground Low Voltage Network To Supply Customers	ISSUE DATE: September, 2015
		REVISION 02
		Page 35 of 78

12.0 LV CABLES DE-RATING FACTORS

LV Cable Ratings given in Table (3) are based on Standard Conditions mentioned in Table (5). For any other different conditions , the LV Cable ratings will be different accordingly and will be corrected by applying the De-rating Factors mentioned in Table (23) & Table (24) & Table (25) by using the following equation :

Corrected LV Cable Rating

- = LV Cable Rating given in Table (3)
- × Burial Depth Correction Factor
- × Soil Thermal Resistivity Correction Factor
- × Ground Temperature Correction Factor

Table (23)
Burial Depth Correction Factors

Burial Depth – m	Correction Factor
0.6	1.05
0.8	1.02
1.0	1.00
1.5	0.96
2.0	0.92
2.5	0.90
3.0	0.87
4.0	0.84
5.0	0.82

Note: Burial depth refers to the distance from the center of the cable installation to the final grade (surface) level.

Table (24)
Soil Thermal Resistivity Correction Factors

Soil Thermal Resistivity - °C.m/w	Correction Factor
1.2	1.14
1.5	1.08
2.0	1.00
2.5	0.92
3.0	0.86

Note: The value of soil thermal Resistivity chosen shall make full allowance for dry-out of the soil adjacent to the cables, due to heat emission from the cables. All soil within the 50°C. isotherm surrounding the cables should be assumed to be dry. The soil at the ground surface should also be assumed to be dry. Thus the value of soil thermal Resistivity chosen shall be higher than the background value derived from site measurements.



Table (25)
Ground Temperature Correction Factors

Ground Temperature - °C	Correction Factor
30	1.04
35	1.00
40	0.95

SEC Service Standard Conditions :

Table (26)

Ambient Temperature Direct Buried/ Underground Ducted, at depths of one (1) meter and more	40 °C.
Soil Thermal Resistivity, at depths of one (1) meter and more	2.0 °C.m/w
Maximum Continuous Conductor Operating Temperature (XLPE)	90 °C
Maximum Short Circuit Conductor Temperature – 5 second Maximum Duration (XLPE)	250 °C
Loss Load Factor – Daily (Equivalent Load Factor = 0.88)	0.8
Burial Depth (to the center of the cable)	0.54 m
Circuit Spacing (center to center)	0.30 m

The Corrected Ratings (Current Carrying Capacity) of LV Cables at SEC Service Standard Conditions mentioned in Table (26) are calculated by applying the De-rating Factors mentioned in Table (23) & Table (24) & Table (25) on the Cable Ratings given in Table (3) by using the Equation above as follows :

$$\text{Corrected Cable Rating (300 mm}^2 \text{ Cable)} = 310 \times 1.05 \times 1.0 \times 0.95 = 310 \text{ Amp}$$

$$\text{Corrected Cable Rating (185 mm}^2 \text{ Cable)} = 230 \times 1.05 \times 1.0 \times 0.95 = 230 \text{ Amp}$$

$$\text{Corrected Cable Rating (70 mm}^2 \text{ Cable)} = 135 \times 1.05 \times 1.0 \times 0.95 = 135 \text{ Amp}$$

This concludes that the Corrected De-rated Capacity of LV Cables based on SEC Standard Service Conditions are as shown in Table (27).

Table (27)

LV Cable Size	Corrected De-rated Capacity (Amps)
4 X 300 mm ² AL	310
4 X 185 mm ² AL	230
4 X 70 mm ² AL	135

	الشركة السعودية للكهرباء Saudi Electricity Company	DISTRIBUTION PLANNING STANDARD DPS-02
	DISTRIBUTION PLANNING STANDARD Design Guideline Of Underground Low Voltage Network To Supply Customers	ISSUE DATE: September, 2015
		REVISION 02
		Page 37 of 78

13.0 SUPPLY METHOD FOR LV LARGE METERS (300 , 400 , 500 , 600 , 800 AMP)

The following Tables (Table 31 & Table 32 & Table 33 & Table 34 & Table 35) show the supply method for LV Large Meters (300 , 400 , 500 , 600 , 800 Amp) in Underground LV Networks for different Demand Load Type by applying the design principles described in Section No. (10.0) and taking in consideration the following points :

- 1) The LV Cables Rating :

Table (28)

Cable Size	Rating	1 Cable	2 Cables
		Max	Max
mm ²	Amp	Amp	Amp
300 mm² Cable	310	310	620
185 mm² Cable	230	230	460
70 mm² Cable	135	135	270

- 2) The Distribution Pillar's Firm Capacity and the rating of Outgoing Fuse of the distribution pillar and the rating of Outgoing MCCB of the substation :

Table (29)

Substation	Distribution Pillar	Distribution Pillar
Outgoing MCCB Rating	Outgoing Fuse Rating	Firm Capacity
(Amp)	(Amp)	(Amp)
400	200	320

- 3) The capability of Cable connections to the outgoings of the distribution pillar and the outgoings of the substation and the capability of Cable connections to the incomings of the Meter Boxes (300 , 400 , 500 , 600 Amp) and Service Cabinet for (800 Amp) Meter:

Table (30)

Connection Point	Capability of Cable Connections
Outgoings of the Substation	1 Cable Up to 300 mm ² per Outgoing
Outgoings of the Distribution Pillar	1 Cable Up to 185 mm ² per Outgoing
Meter Box 300 Amp	Two Incomings Up to 1 Cable 300 mm ² + 1 Cable 185 mm ²
Meter Box 400 Amp	Two Incomings Up to 1 Cable 300 mm ² + 1 Cable 185 mm ²
Meter Box 500 Amp	Two Incomings Up to 1 Cable 300 mm ² per incoming
Meter Box 600 Amp	Two Incomings Up to 1 Cable 300 mm ² per incoming
Service Cabinet (800 Amp) Meter	Two Incomings Up to 1 Cable 300 mm ² per incoming



الشركة السعودية للكهرباء

Saudi Electricity Company

**DISTRIBUTION PLANNING STANDARD
Design Guideline Of Underground Low
Voltage Network To Supply Customers**

**DISTRIBUTION PLANNING STANDARD
DPS-02**

ISSUE DATE:

September, 2015

REVISION

02

Page 38 of 78

Also the following Tables (Table 31 & Table 32 & Table 33 & Table 34 & Table 35) are created for two Scenarios :

- A. Using of 1 Outgoing and 1 Cable
- B. Using of 2 Outgoings and 2 Cables

The planning engineer should study the supply request according to these options and evaluate the cost and the voltage drop for each one then to select the suitable option and the most economical one.

The supply method for these types of LV Large Meters need special configurations design as follows :

(a) Two Outgoings from Distribution Pillar to Meter Box

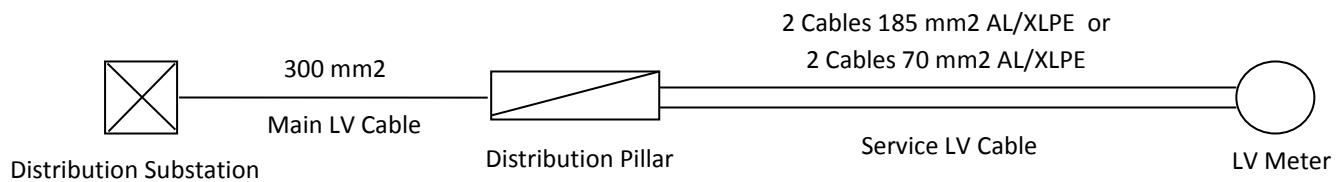


Figure (7)

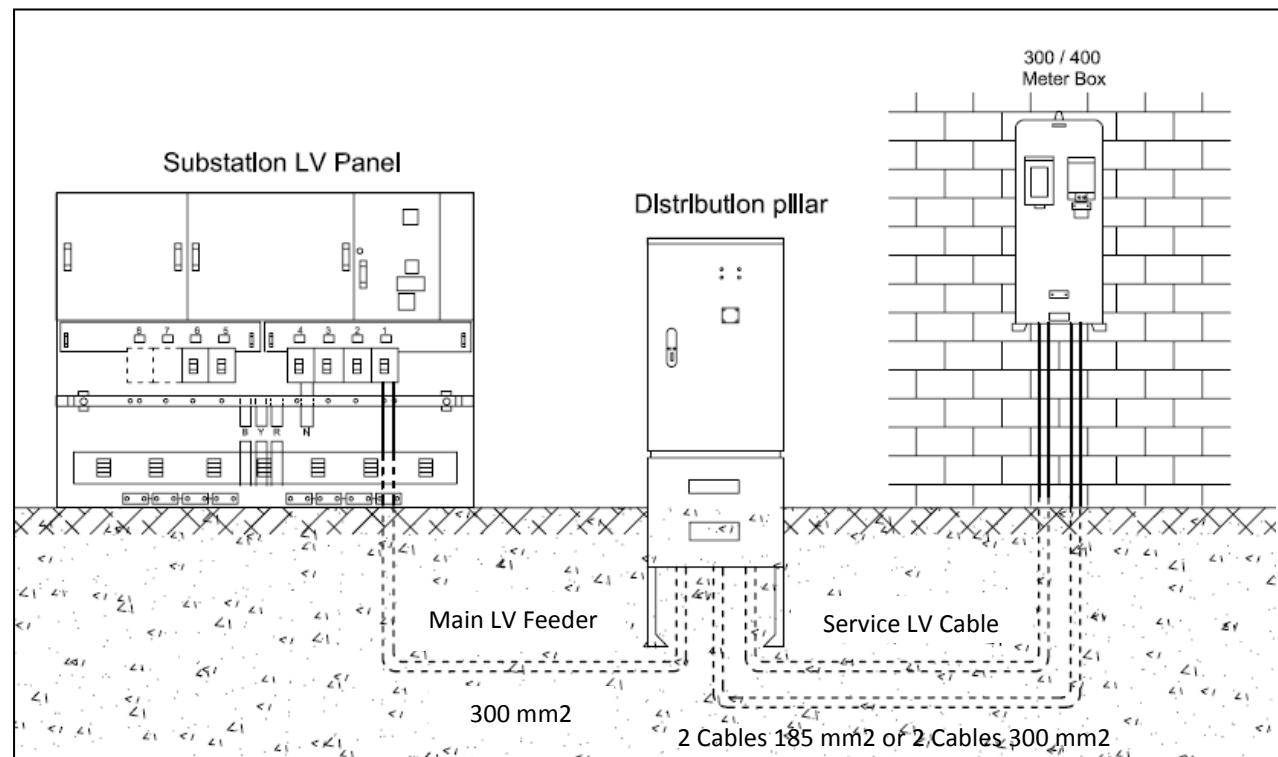


Figure (8)



الشركة السعودية للكهرباء

Saudi Electricity Company

**DISTRIBUTION PLANNING STANDARD
Design Guideline Of Underground Low
Voltage Network To Supply Customers**

DISTRIBUTION PLANNING STANDARD
DPS-02

ISSUE DATE:

REVISION

September, 2015

02

Page 39 of 78

(b) Two Outgoings from Substation to Meter Box

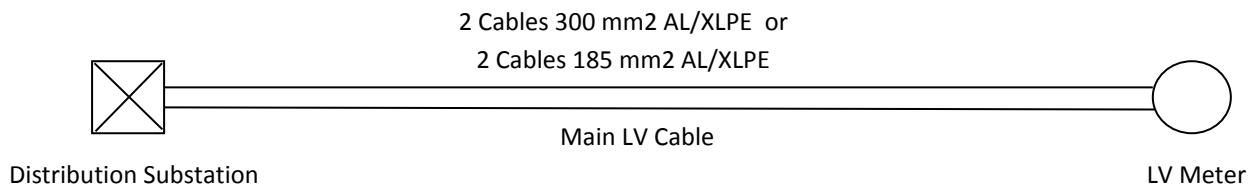


Figure (9)

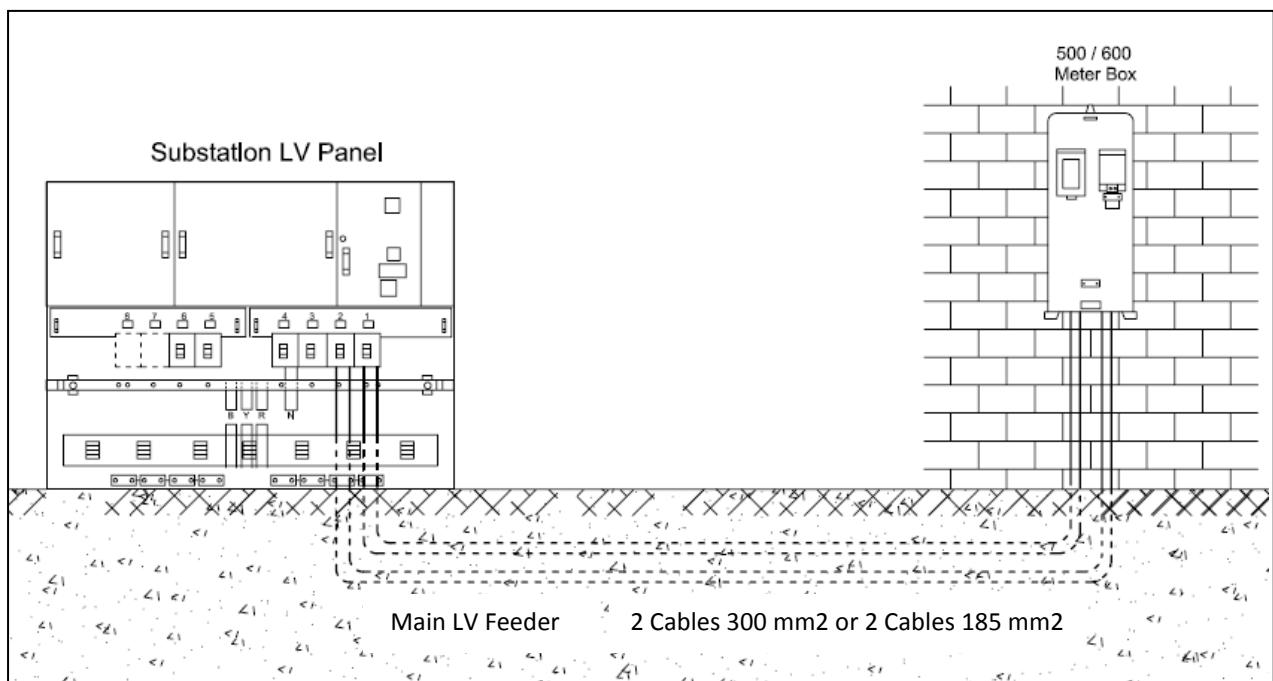


Figure (10)



(c) Two Outgoings from Substation to Service Cabinet (800 Amp) Meter

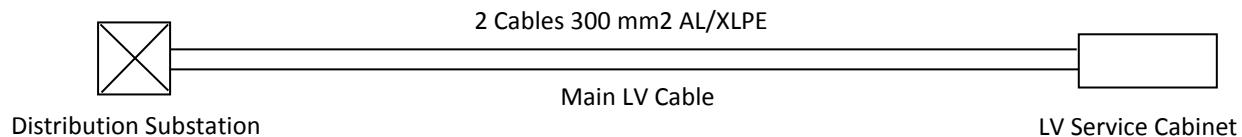


Figure (11)

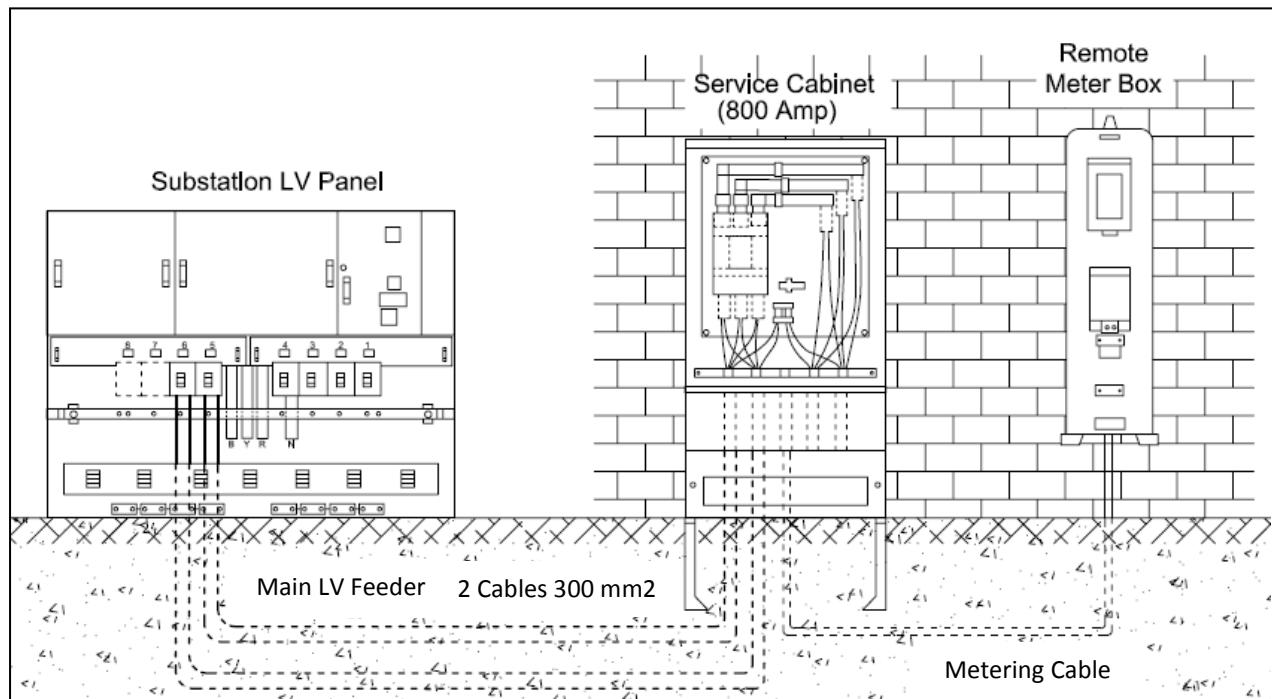


Figure (12)

13.1 Supply Method for 300 Amp LV Meter

Table (31)

Limitation Scenario			Option 1				Option 2			
			Using of 1 Outgoing and 1 Cable			Using of 2 Outgoings and 2 Cables				
CB Rating (Amp)	DF	Demand Load (Amp)	Supply Source	No. of Outgoings	No. of Cables	Cable Size (mm²)	Supply Source	No. of Outgoings	No. of Cables	Cable Size (mm²)
300	0.5	150	SS	1	1	185	DP	2	2	70
300	0.6	180	SS	1	1	185	DP	2	2	70
300	0.7	210	SS	1	1	185	DP	2	2	70
300	0.8	240	SS	1	1	300	DP	2	2	70
300	0.9	270	SS	1	1	300	DP	2	2	70

SS = Substation

DP = Distribution Pillar



الشركة السعودية للكهرباء

Saudi Electricity Company

**DISTRIBUTION PLANNING STANDARD
Design Guideline Of Underground Low
Voltage Network To Supply Customers**

**DISTRIBUTION PLANNING STANDARD
DPS-02**

ISSUE DATE:

September, 2015

REVISION

02

Page 41 of 78

13.2 Supply Method for 400 Amp LV Meter

Table (32)

Limitation Scenario			Option 1				Option 2			
			Using of 1 Outgoing and 1 Cable				Using of 2 Outgoings and 2 Cables			
CB Rating (Amp)	DF	Demand Load (Amp)	Supply Source	No. of Outgoings	No. of Cables	Cable Size (mm ²)	Supply Source	No. of Outgoings	No. of Cables	Cable Size (mm ²)
400	0.5	200	SS	1	1	185	DP	2	2	70
400	0.6	240	SS	1	1	300	DP	2	2	70
400	0.7	280	SS	1	1	300	DP	2	2	185
400	0.8	320	SS	N/A	N/A	N/A	SS	2	2	185
400	0.9	360	SS	N/A	N/A	N/A	SS	2	2	185

13.3 Supply Method for 500 Amp LV Meter

Table (33)

Limitation Scenario			Option 1				Option 2			
			Using of 1 Outgoing and 1 Cable				Using of 2 Outgoings and 2 Cables			
CB Rating (Amp)	DF	Demand Load (Amp)	Supply Source	No. of Outgoings	No. of Cables	Cable Size (mm ²)	Supply Source	No. of Outgoings	No. of Cables	Cable Size (mm ²)
500	0.5	250	SS	N/A	N/A	N/A	SS	2	2	70
500	0.6	300	SS	N/A	N/A	N/A	SS	2	2	185
500	0.7	350	SS	N/A	N/A	N/A	SS	2	2	185
500	0.8	400	SS	N/A	N/A	N/A	SS	2	2	185
500	0.9	450	SS	N/A	N/A	N/A	SS	2	2	185

13.4 Supply Method for 600 Amp LV Meter

Table (34)

Limitation Scenario			Option 1				Option 2			
			Using of 1 Outgoing and 1 Cable				Using of 2 Outgoings and 2 Cables			
CB Rating (Amp)	DF	Demand Load (Amp)	Supply Source	No. of Outgoings	No. of Cables	Cable Size (mm ²)	Supply Source	No. of Outgoings	No. of Cables	Cable Size (mm ²)
600	0.5	300	SS	N/A	N/A	N/A	SS	2	2	185
600	0.6	360	SS	N/A	N/A	N/A	SS	2	2	185
600	0.7	420	SS	N/A	N/A	N/A	SS	2	2	185
600	0.8	480	SS	N/A	N/A	N/A	SS	2	2	300
600	0.9	540	SS	N/A	N/A	N/A	SS	2	2	300



13.5 Supply Method for 800 Amp LV Meter

Table (35)

Limitation Scenario			Option 1				Option 2			
			Using of 1 Outgoing and 1 Cable				Using of 2 Outgoings and 2 Cables			
CB Rating (Amp)	DF	Demand Load (Amp)	Supply Source	No. of Outgoings	No. of Cables	Cable Size (mm ²)	Supply Source	No. of Outgoings	No. of Cables	Cable Size (mm ²)
800	0.5	400	SS	N/A	N/A	N/A	SS	2	2	185
800	0.6	480	SS	N/A	N/A	N/A	SS	2	2	300
800	0.7	560	SS	N/A	N/A	N/A	SS	2	2	300
800	0.8	640	SS	N/A	N/A	N/A	SS	2	2	300
800	0.9	720	SS	N/A	N/A	N/A	SS	2	2	300

Low Voltage Service Cabinet is intended to be used for outdoor installation to feed bulk consumers of loads 800A in the Distribution Network as shown in Figure (12) above. The service cabinet shall have one 800A rated MCCB.

The in-coming circuit terminals of the MCCB shall be suitable for fixing two aluminum cables of size up to 4x300 mm² with the use of SEC standard cable lugs.

Detailed materials specifications for LV Service Cabinet For 800A Bulk Customers are referred to SEC Distribution Materials Specification No. (42-SDMS-02, Rev.00) with its latest updates.

	الشركة السعودية للكهرباء Saudi Electricity Company	DISTRIBUTION PLANNING STANDARD DPS-02
	DISTRIBUTION PLANNING STANDARD Design Guideline Of Underground Low Voltage Network To Supply Customers	ISSUE DATE: September, 2015
	REVISION 02	
		Page 43 of 78

14.0 SUPPLY METHOD FOR LV CUSTOMERS WITH LOAD MORE THAN 800 AMP BY PRIVATE / DEDICATED DISTRIBUTION SUBSTATIONS

Supplying of LV Customers by Private/ Dedicated Substations can be used for the following major cases :

- 1) When the connected load of the customer's unit is more than 800 Amp and the customer building is considered as one unit according to Customer Services Manual and according to municipality permits.
- 2) When there is no other customer can be supplied from the proposed substation and the demand load of the customer's unit is 300 KVA or more and the customer building is considered as one unit according to Customer Services Manual and according to municipality permits.
- 3) When the customer ask for Private / Dedicated Substations for any specific reason.

The customer should provide the location of the proposed Private/ Dedicated Substations according to SEC specification.

The no. of the substations and their ratings should be the nearest rating available according to SEC specification to match the calculated coincident demand load of the customer building unless the customer ask for more than demand load. The contracted load is the rating of the transformer. For more details follow the procedures as below :

- 1) Calculate connected load according to SEC standards (DPS-01)
- 2) Apply demand factor and coincident factor according to SEC standards (DPS-01) to calculate the Coincident Demand Load (CDL).
- 3) Select the no. of the required substations and their KVA ratings from the available SEC standard (300, 500, 1000, 1500 KVA) where the summation of substations ratings should provide minimum sufficient total capacity (100 % of substation's rated capacity) to meet the calculated Coincident Demand Load (CDL) with minimum no. of substations.
- 4) If the customer asks to supply his building by a load more than calculated demand load justified by calculation study for declared loads, in this case the demand load as requested by the customer should be considered instead of the calculated demand load.

The supply method for these types of customers needs special configurations design as follows :



(a) Unit/Package Substation with LV Panel with Main Circuit Breaker and KWH Meter and without Outgoing MCCBs

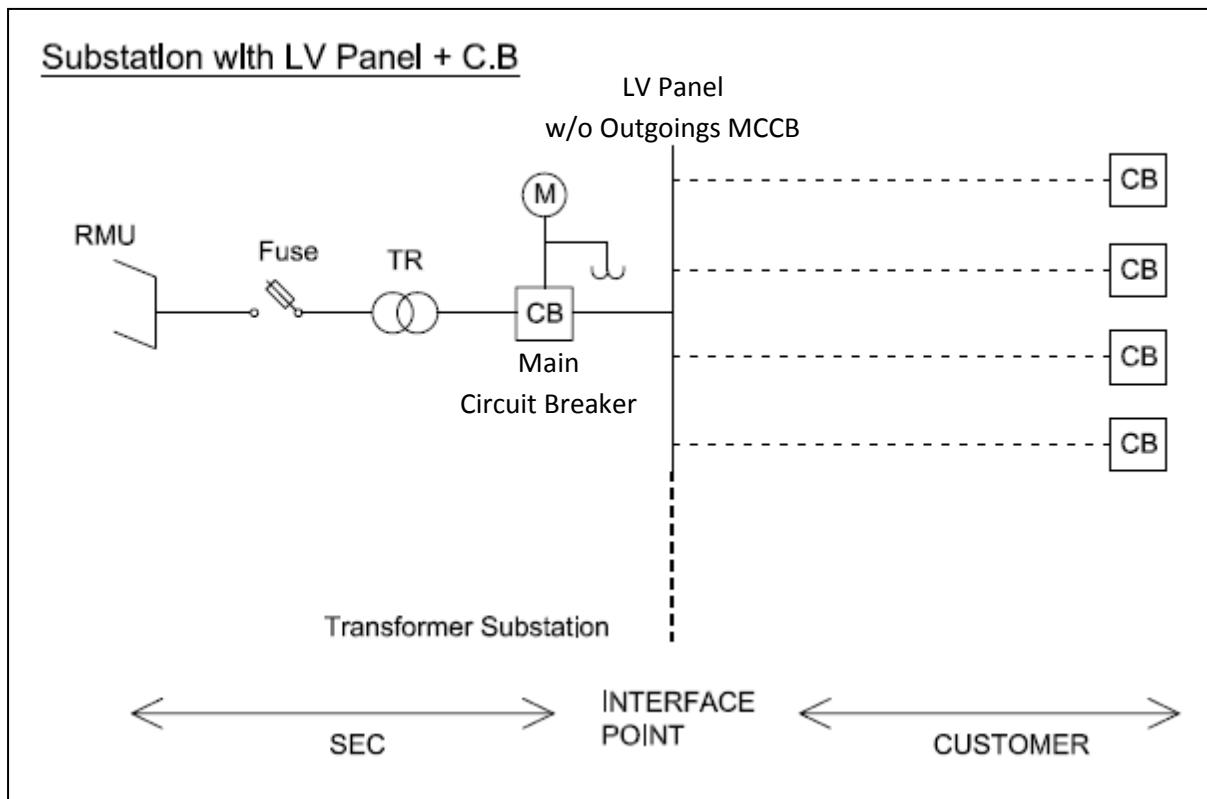


Figure (13)

Low Voltage Distribution Panel without Outgoing MCCBs is to be used in the distribution substations for this configuration type. The panel shall be supplied with Main Circuit Breaker. SEC approved main Circuit breaker (MCCB/ACB) shall be as per specification no. 37-SDMS-04. Outgoing connection to consumer shall be made by means of connecting 630 mm copper cables to the main bus bars by using cable lugs. General characteristics of this Panel are shown in Table (36).

Table (36)

Secondary Voltage (V)	400/230			231/133		
Transformer Rating (KVA)	500	1000	1500	500	1000	1500
L.V. Panel Rating (A)	800	1600	2500	1600	3000	4000

Detailed materials specifications for LV Distribution Panel without Outgoing Circuit Breakers are referred to SEC Distribution Materials Specification No. (31-SDMS-04, Rev.00) and No. (31-SDMS-06, Rev.00) with its latest updates.



(b) RMU with Transformer with KWH Meter and without LV Panel

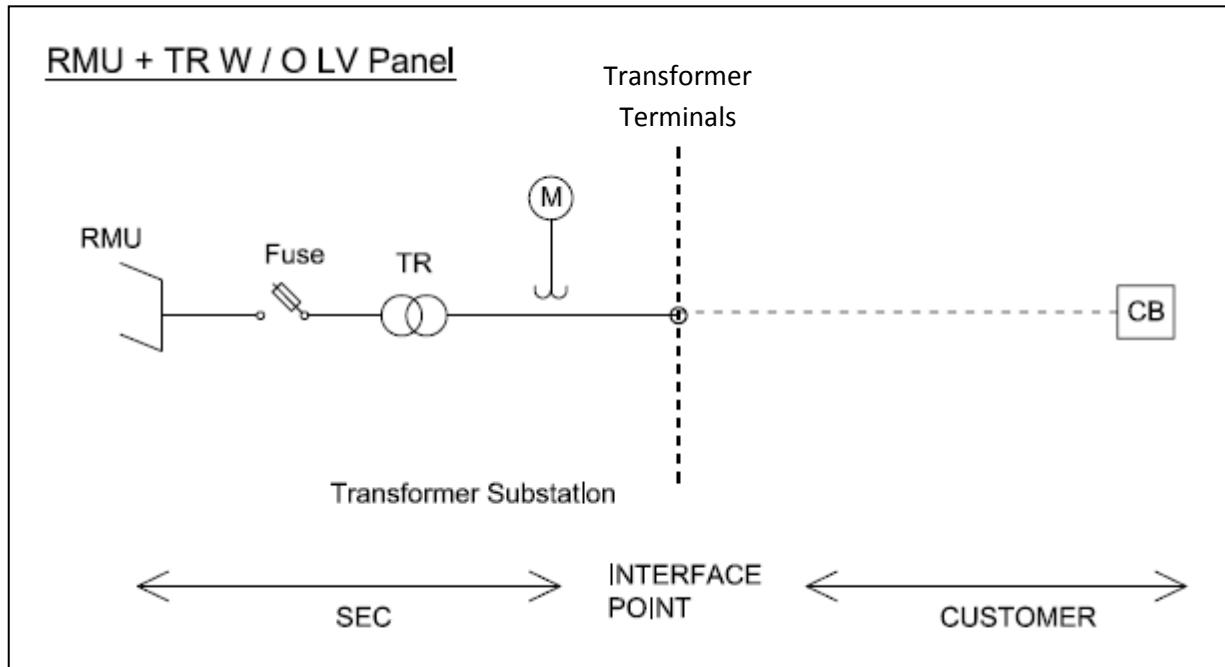


Figure (14)

Interface Low Voltage Main Circuit Breaker is to be used in the LV distribution system for this configuration type. These Circuit Breakers are supplied by the Consumer. At the boundary between SEC and Consumer inside the Consumer panel which shall be fed directly from the SEC transformer or the LV Distribution Board through single core copper, XLPE insulated 630mm² cables.

The Circuit Breakers are required in seven different capacities to have the following current ratings :

(1000 A , 1250 A , 1600 A , 2000 A , 2500 A , 3200 A , 4000 A).

The terminals shall be suitable for installation of 630mm² Cable by using SEC standard cable lugs. The number of single core cable per phase corresponding to each breaker capacity shall be as per Table (37) below :

Table (37)

Breaker Rated Current	1000 A	1250 A	1600 A	2000 A	2500 A	3200 A	4000 A
No. Of Cable/Phase	2	2	2	4	4	4	6

Detailed materials specifications for Interface Low Voltage Main Circuit Breakers are referred to SEC Distribution Materials Specification No. (37-SDMS-04, Rev.00) with its latest updates.



15.0 SPECIAL CASE : LV NETWORK WITH RING SYSTEM

If there is a special area / customer need higher level of reliability by providing two point of supply (one as main supply and the second as back-up supply) from different Substation to the customers at Low Voltage Network level (for example: Al Mashaer Al Moqadasah), in this special case , the LV Network with Ring System Design can be used with approval from the authorized level of management.

The design configuration of the Ring System for LV Network is executed by supplying each distribution pillar by two different main LV feeders from two different substations. The design configuration should satisfy the following considerations :

- 1) Each main LV feeder should be design to carry the full demand load of the distribution pillar.
- 2) Each Substation should be design to carry the full demand load of the distribution pillar.
- 3) In normal operation only one from the two main LV feeders will be energized by closing its MCCB from substation side and the other one should be not energized by opening its MCCB from substation side. Parallel operation is not allowed between the two main LV feeders.
- 4) It is preferred that the two different substations to be fed from different MV feeders if it is possible.

The supply method of the Ring System for LV Network needs special configurations design as shown in figure (15) below :

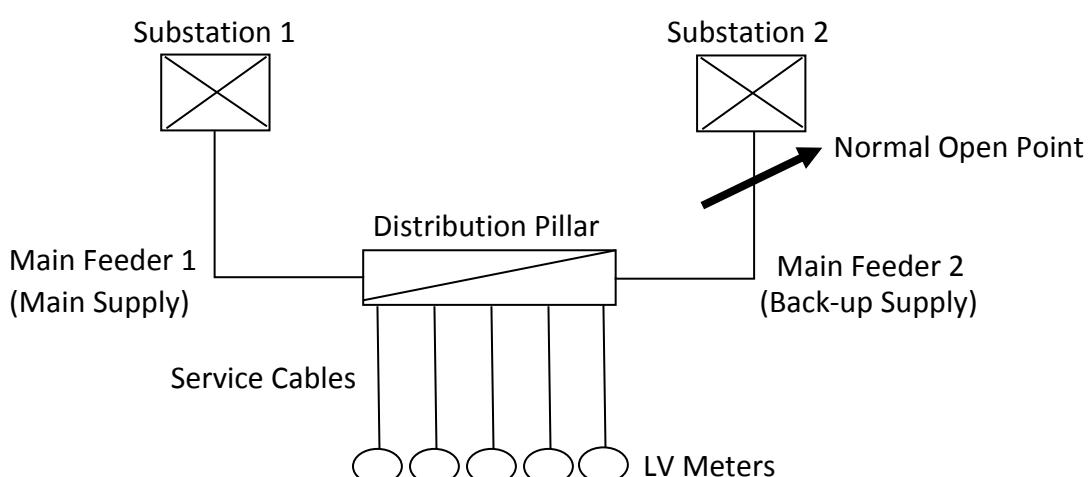


Figure (15)

	الشركة السعودية للكهرباء Saudi Electricity Company	DISTRIBUTION PLANNING STANDARD DPS-02
	DISTRIBUTION PLANNING STANDARD Design Guideline Of Underground Low Voltage Network To Supply Customers	ISSUE DATE: September, 2015
	REVISION 02	
		Page 47 of 78

16.0 SPECIAL CASE : LV NETWORK FOR HAJJ AREA

Hajj Load is intended any building used for pilgrims lodging. The Hajj Area is the area which has permits from municipality to build buildings using for pilgrims lodging. For these areas with this type, the design of its Underground LV Networks should be based on the following special considerations :

1. The Demand Factor (DF) is 0.9.
2. The Coincident Factor (CF) is 1.0.

17.0 SPECIAL CASE : LV NETWORK FOR RANDOM AREA

The Random Area is the area which is considered as un-planned area according to the municipality and which has many buildings without construction permits from the municipality. Usually in this area type, the un-permitted buildings get the supply illegally from the permitted buildings. For these areas with this type, the design of its Underground LV Networks should be based on the following special considerations :

1. The Demand Factor (DF) is 1.0.
2. The Coincident Factor (CF) is 0.8.

18.0 SPECIAL CASE : LV NETWORK FOR COMMERCIAL CENTER

The Commercial Center or any group of commercial shops which apply common working time so that all its shops are to be opened and closed at the same time , for this type of commercial shops , the design of its Underground LV Networks should be based on the following special considerations :

1. The Demand Factor (DF) is 0.7.
2. The Coincident Factor (CF) is 1.0.

19.0 SPECIAL CASE : COINCIDENT DEMAND LOAD CALCULATION FOR COMMERCIAL OFFICES BUILDINGS

The Commercial Offices Building which apply common working time so that all its Offices are to be opened and closed at the same time , for this type of commercial

	الشركة السعودية للكهرباء Saudi Electricity Company	DISTRIBUTION PLANNING STANDARD DPS-02
	DISTRIBUTION PLANNING STANDARD Design Guideline Of Underground Low Voltage Network To Supply Customers	ISSUE DATE: September, 2015
	REVISION 02	
		Page 48 of 78

Offices, the Calculation of Coincident Demand Load should be based on the following special considerations :

1. The Coincident Factor (CF) is 1.0.
2. The Demand Factor (DF) is 0.7

20.0 SPECIAL CASE : COINCIDENT DEMAND LOAD CALCULATION FOR COMPLEX OF WORKSHOPS

The Complex Of Workshops which apply common working time so that all its Workshops are to be opened and closed at the same time , for this type of Workshops, the Calculation of Coincident Demand Load should be based on the following special considerations :

1. The Coincident Factor (CF) is 1.0.
2. The Demand Factor (DF) is 0.9.

21.0 POWER SUPPLY OF NEW PLOT PLAN

Design of LV Underground Network for New Plot Plan should be referred to SEC Distribution Planning Standards No. (DPS-09, DPS-10) named (General Guide Lines for Design of Distribution Network of Private Plot Plans) with its latest updates.

22.0 REINFORCEMENT OF UNDERGROUND LOW VOLTAGE NETWORK

Principles and procedures for Reinforcement of Low Voltage Underground Network will be in a separate special Guideline which is under preparing by DPS Committee.

23.0 EXEMPTION OF DISTRIBUTION SUBSTATION LOCATION

Principles and procedures for Exemption of Customers from providing of Distribution Substation Location in Low Voltage Underground Network will be in a separate special Guideline which is under preparing by DPS Committee.

	الشركة السعودية للكهرباء Saudi Electricity Company	DISTRIBUTION PLANNING STANDARD DPS-02
	DISTRIBUTION PLANNING STANDARD Design Guideline Of Underground Low Voltage Network To Supply Customers	ISSUE DATE: September, 2015
	REVISION 02	
		Page 49 of 78

24.0 ADVANTAGEOUS MODULES AND TABLES

Software Modules are already built in EXCEL format and attached in the Appendixes for the following subjects :

- a) Design of Underground Low Voltage Network (Appendix A1).
- b) Design of Substations required to supply an Area (Appendix A2).
- c) Voltage Drop Calculations (Appendix A3 , A4).

Also Advantageous Tables are already built in EXCEL format and attached in the Appendix for the following subjects :

- a) No. of Meters can be supplied by (SS , DP , LV Cables) for different Demand Factors (0.6 , 0.7 , 0.8 , 0.9) and for different CB Ratings (20 ,30, 40 , 50 , 70 , 100 , 125 , 150 , 200 , 250 , 300 , 400 , 500 , 600 , 800 A) in different Nominal Voltages (400 , 380 , 220 V). (Appendix A5 , A6 , A7 , A8 , A9 , A10 , A11)
- b) Max Lengths (m) can be achieved within allowed Voltage Drop (5% , 3.5% , 1.5%) in different Nominal Voltages (400 , 380 , 220 V) with different LV Cables' Sizes (300 , 185 , 70 mm²) for different Coincident Demand Load.
 (Appendix A12 , A13 , A14)
- c) Voltage Drop (%) in different Nominal Voltages (400 , 380 , 220 V) with different LV Cables' Sizes (300 , 185 , 70 mm²) for different Coincident Demand Load (KVA) with different Cables' Length (m).
 (Appendix A15 , A16 , A17 , A18 , A19 , A20 , A21 , A22 , A23)
- d) Demand Factor Values (Appendix A24)
- e) Coincident Factor Values (Appendix A25)



25.0 TYPICAL LAYOUT FOR UNDERGROUND LOW VOLTAGE NETWORK

Typical layout for design of Underground Low Voltage Network with typical location of Substations at center of load and typical location of Distribution Pillars at middle between lots (center of load) is illustrated in the following drawing in figure (16) below.

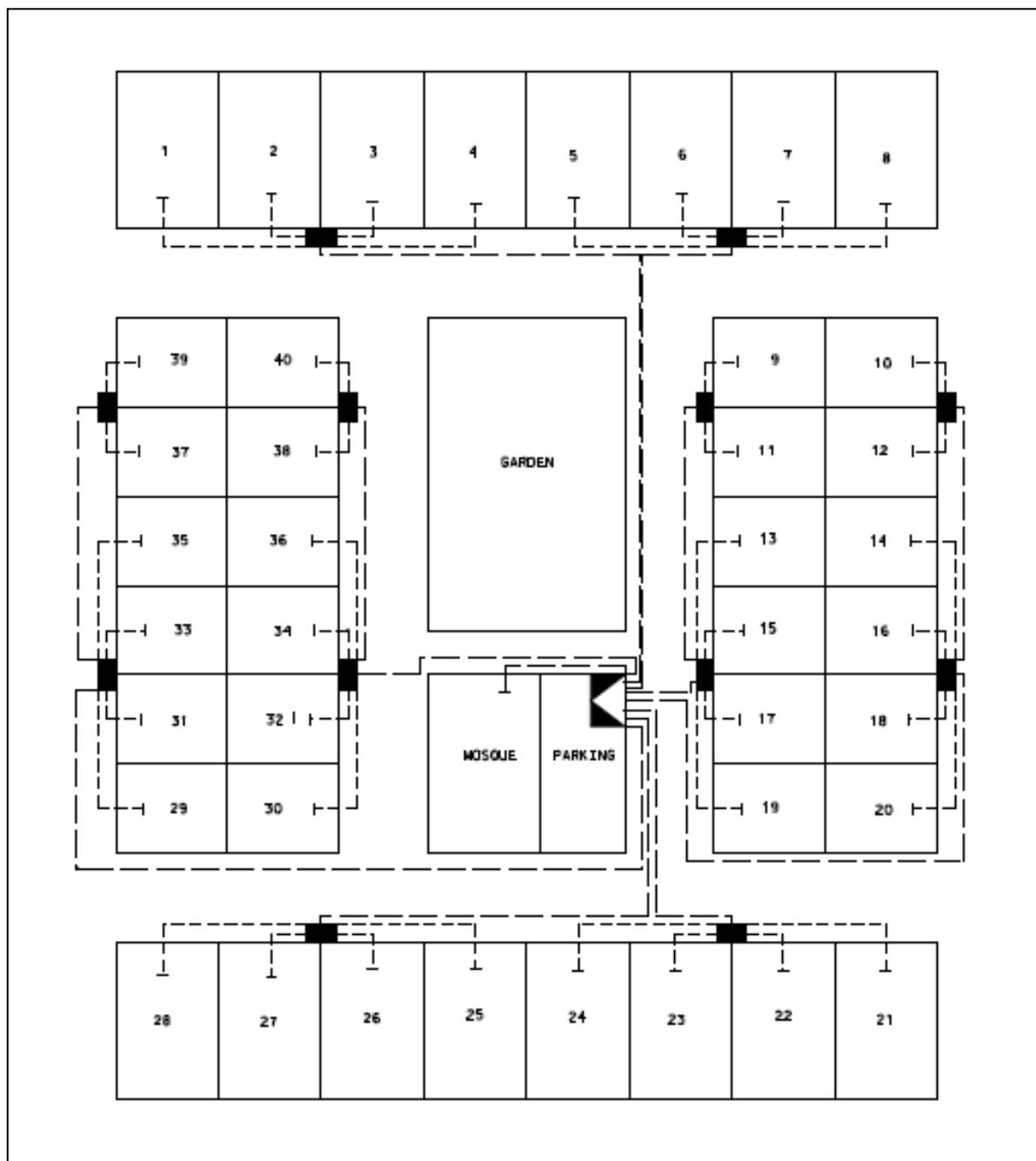


Figure (16)



26.0 TYPICAL DISTRIBUTED LOADS PER OUTGOING OF THE SUBSTATION

Table (38) shows the typical distributed loads per outgoing of the substation to reach full utilization of substation's firm capacity for different ratings of substations (300 , 500 , 1000 , 1500 KVA) and for different nominal voltages (400 , 380 , 220 V).

Table (38)

Secondary Voltage (V)	Transformer Rating (KVA)	LV Panel Rating (A)	Number of Outgoing MCCB's	Transformer Rating (A)	Load per Outgoing (A)
400	300	500	2	433	217
400	500	800	4	722	180
400	1000	1600	8	1443	180
400	1500	2500	10	2165	217
380	300	500	2	456	228
380	500	800	4	760	190
380	1000	1600	8	1519	190
380	1500	2500	10	2279	228
220	300	800	4	787	197
220	500	1600	8	1312	164
220	1000	3000	12	2624	219
220	1500	4000	14	3936	281

	الشركة السعودية للكهرباء Saudi Electricity Company	DISTRIBUTION PLANNING STANDARD DPS-02
	DISTRIBUTION PLANNING STANDARD Design Guideline Of Underground Low Voltage Network To Supply Customers	ISSUE DATE: September, 2015
		REVISION 02
		Page 52 of 78

APPENDIXES

- A1. MODULE FOR DESIGN OF UNDERGROUND LOW VOLTAGE NETWORK
- A2. MODULE FOR DESIGN OF SUBSTATIONS REQUIRED TO SUPPLY AN AREA
- A3. MODULE FOR VOLTAGE DROP CALCULATIONS (THROUGH DP)
- A4. MODULE FOR VOLTAGE DROP CALCULATIONS (DIRECT FEEDER)
- A5. TABLE FOR NO. OF METERS CAN BE SUPPLIED BY (LV CABLES , DP)
- A6. TABLE FOR NO. OF METERS CAN BE SUPPLIED BY (SS 400 V)
- A7. TABLE FOR NO. OF METERS CAN BE SUPPLIED BY (SS 380 V)
- A8. TABLE FOR NO. OF METERS CAN BE SUPPLIED BY (SS 220 V)
- A9. TABLE FOR NO. OF METERS CAN BE SUPPLIED (IN HAJJ AREA)
- A10. TABLE FOR NO. OF METERS CAN BE SUPPLIED (IN RANDOM AREA)
- A11. TABLE FOR NO. OF METERS CAN BE SUPPLIED (FOR COMMERCIAL CENTER)
- A12. TABLE FOR MAX LENGTHS WITHIN (5%) VOLTAGE DROP
- A13. TABLE FOR MAX LENGTHS WITHIN (3.5%) VOLTAGE DROP
- A14. TABLE FOR MAX LENGTHS WITHIN (1.5%) VOLTAGE DROP
- A15. TABLE FOR VOLTAGE DROP (%) IN (400 V) WITH (300 MM² CABLE)
- A16. TABLE FOR VOLTAGE DROP (%) IN (400 V) WITH (185 MM² CABLE)
- A17. TABLE FOR VOLTAGE DROP (%) IN (400 V) WITH (70 MM² CABLE)
- A18. TABLE FOR VOLTAGE DROP (%) IN (380 V) WITH (300 MM² CABLE)
- A19. TABLE FOR VOLTAGE DROP (%) IN (380 V) WITH (185 MM² CABLE)
- A20. TABLE FOR VOLTAGE DROP (%) IN (380 V) WITH (70 MM² CABLE)
- A21. TABLE FOR VOLTAGE DROP (%) IN (220 V) WITH (300 MM² CABLE)
- A22. TABLE FOR VOLTAGE DROP (%) IN (220 V) WITH (185 MM² CABLE)
- A23. TABLE FOR VOLTAGE DROP (%) IN (220 V) WITH (70 MM² CABLE)
- A24. TABLE FOR DEMAND FACTOR VALUES
- A25. TABLE FOR COINCIDENT FACTOR VALUES
- A26. REFERENCES



الشركة السعودية للكهرباء

Saudi Electricity Company

**DISTRIBUTION PLANNING STANDARD
Design Guideline Of Underground Low
Voltage Network To Supply Customers**

DISTRIBUTION PLANNING STANDARD
DPS-02

ISSUE DATE:

September, 2015

REVISION

02

Page 53 of 78

A1. MODULE FOR DESIGN OF UNDERGROUND LOW VOLTAGE NETWORK

This Software Module is already built in EXCEL format. It makes all the calculations of Voltage Drop and Loading Percentage on LV Cables and Distribution Pillars and Substation, required for design of Underground Low Voltage Network.

Module for Design of Underground LV Network, Nominal Voltage $V = V_0$											
FROM SUBSTATION TRANSFORMER (SS) TO DISTRIBUTION PILLAR (DP)											
FROM DISTRIBUTION PILLAR (DP) TO CUSTOMER PLOT											
FEEDER	DL	N	CF	CDL	CDL	Cable1	L1	CDL	VD1	PL	CBR
NO.	(kV/A)								N		
									(A)	(A)	
									%	(kV/A)	
F1							1				
							2				
							3				
							4				
							5				
							6				
							7				
							8				
F2							9				
							10				
							11				
							12				
							13				
F3							14				
							15				
							16				
							17				
							18				
F4							19				
							20				
							21				
							22				
F5							23				
							24				
							25				
							26				
F6							27				
							28				
							29				
							30				
F7							31				
							32				
							33				
F8							34				
							35				
							36				
							37				
							38				
							39				
							40				

TOTAL NO. OF PLOT = _____
 N= TOTAL NO. OF KWH METERS= _____
 SS Rating kVA = _____
 TOTAL PERCENTAGE LOAD ON SS (%) = _____
 TOTAL LOAD ON SS (kVA) = _____
 kVA
 kVA
 kVA

**A2. MODULE FOR DESIGN OF SUBSTATIONS REQUIRED TO SUPPLY AN AREA**

This Software Module is already built in EXCEL format. It makes the calculations to estimate No. of Substations with a certain rating required to supply an area .

Module for Design of Substations Required to Supply an Area :**Substation kVA =**

Plot Area (Average) (m ²)	Construction Area (%)	Number of Floors	No. of Units in Each Plot	No. of Plots	Built-up Area (m ²)	Load (kV/A)	Total No. of Meters	Coincident Factor	Demand Load	Load on Substation (kV/A)	%age Loading of Substation	Date: #####
					0.0	#N/A	0	#N/A	#N/A	#N/A	#N/A	#N/A

Total No. of Plots in the Scheme	Enter 1 for Commercial, 0 for Residential	Plot Area (Average) (m ²)	No of Substations Required for the Scheme
		0.0	0



A3. MODULE FOR VOLTAGE DROP CALCULATIONS (THROUGH DP)

This Software Module is already built in EXCEL format. It makes the calculations of Voltage Drop from Substation to a Customer supplied through Distribution Pillar and Loading Percentage on LV Cables.

Voltage Drop Study for WR No. [REDACTED]		
Substation No. [REDACTED]	Distribution Pillar No. [REDACTED]	
Loads Statement for customers on DP		Load (Amperes)
Existing		
Future Plan or Under Constructions		
This Work Request no.		
Voltage Drop from Substation to DP		
Cable Length from substation to DP (Meters)	= [REDACTED]	
Demand Factor (DF)	= [REDACTED]	
Demand Load on DP (Amperes)	= 0	0.00 KVA
Coincident Factor for 0 meters on DP	= #DIV/0!	
Coincident Demand Load on DP (Amperes)	= #DIV/0! Amperes	#DIV/0! KVA
Cable (4x300 mm ² AL) Constant (K)	= [REDACTED]	
Cable Rated Capacity	= A	
% Loading of cable w.r.t. Rated Capacity	= #DIV/0! %	
% Voltage Drop = (KVAXL)/K	#DIV/0! %	
Voltage Drop from DP to Work Request		
Cable Length from DP to Work Request (Meters)	= [REDACTED]	
Demand Factor (DF)	= [REDACTED]	
Demand Load of Work Request (Amperes)	= 0	0.00 KVA
Coincident Factor for 0 Customers	= #DIV/0!	
Coincident Demand Load of Work Request	= #DIV/0! Amperes	#DIV/0! KVA
Cable (4x185 mm ² AL) Constant (K)	= [REDACTED]	
Cable Rated Capacity	= Amperes	
% Loading of cable w.r.t. Rated Capacity	= #DIV/0! %	
% Voltage Drop = (KVAXL)/K	#DIV/0! %	
Total Voltage Drop from Substation to Work Request #DIV/0! %		
Total distance from substation 0 Meters		
S/S 0	0 A ----->	WR: 0 A
	0 Meters	0 Meters



A4. MODULE FOR VOLTAGE DROP CALCULATIONS (DIRECT FEEDER)

This Software Module is already built in EXCEL format. It makes the calculations of Voltage Drop from Substation to a Customer supplied by Direct Feeder and Loading Percentage on LV Cable.

Voltage Drop Calculations for WR no.

Study from Substation No.

Voltage drop from SS 0 to 0

Direct Feeder from the substation

Total Load of WR = A 0 KVA

No. of cables = cables

Load of WR for one cable = #DIV/0!

Cable Length from substation to Work Request = M

Demand Factor (DF) for Residential Load = #DIV/0! #DIV/0! KVA

Demand Load = #DIV/0!

No. of Meters = #DIV/0! #DIV/0! KVA

Coincident Factor..... = #DIV/0!

Coincident Demand Load = #DIV/0! A #DIV/0! KVA

Cable (4x300 mm² AL) Constant (K) 400 V =

% Voltage Drop =(KVAxL)/K = #DIV/0! %

Cable Loading = #DIV/0! %

Total % Voltage Drop for WR no 0 = #DIV/0! %

Direct distance from substation = 0 Meters

WR:

S/S
0

A

Cable Length 0 Meters

Voltage Drop #DIV/0! %



A5. TABLE FOR NO. OF METERS CAN BE SUPPLIED BY (LV CABLES , DP)

This Table shows No. of Meters can be supplied by the Distribution Pillar and LV Cables (300 , 185 , 70 mm²) for different Demand Factors (0.6 , 0.7 , 0.8 , 0.9) and for different CB Ratings (20 ,30 ,40, 50 ,70, 100 , 125 , 150 , 200 , 250 , 300 , 400) A.



A6. TABLE FOR NO. OF METERS CAN BE SUPPLIED BY (SS 400 V)

This Table shows No. of Meters can be supplied by the Substation in (400 V) LV Underground Network for different Demand Factors (0.6 , 0.7 , 0.8 , 0.9) and for different CB Ratings (20 ,30 ,40, 50 ,70, 100 , 125 , 150 , 200 , 250, 300 , 400 , 500 , 600 , 800) A.



A7. TABLE FOR NO. OF METERS CAN BE SUPPLIED BY (SS 380 V)

This Table shows No. of Meters can be supplied by the Substation in (380 V) LV Underground Network for different Demand Factors (0.6 , 0.7 , 0.8 , 0.9) and for different CB Ratings ((20 ,30 ,40, 50 ,70, 100 , 125 , 150 , 200 , 250, 300 , 400 , 500 , 600 , 800) A.



الشركة السعودية للكهرباء

Saudi Electricity Company

**DISTRIBUTION PLANNING STANDARD
Design Guideline Of Underground Low
Voltage Network To Supply Customers**

**DISTRIBUTION PLANNING STANDARD
DPS-02**

ISSUE DATE:

September, 2015

REVISION

02

Page 60 of 78

A8. TABLE FOR NO. OF METERS CAN BE SUPPLIED BY (SS 220 V)

This Table shows No. of Meters can be supplied by the Substation in (220 V) LV Underground Network for different Demand Factors (0.6 , 0.7 , 0.8 , 0.9) and for different CB Ratings (20 ,30 ,40 ,50 ,70, 100 , 125 , 150 , 200 , 250, 300 , 400 , 500 , 600 , 800) A.

DF	CBR	SS 1500 KVA 220 V			SS 1000 KVA 220 V			SS 500 KVA 220 V			SS 300 KVA 220 V						
		CF	CDL	LOAD	N	CF	CDL	LOAD	N	CF	CDL	LOAD	N	CF	CDL	LOAD	N
A	A	A	A	%	A	A	A	%	A	A	A	%	A	A	A	%	
0.6	20	0.548	3156	80	480	0.551	2109	80	319	0.557	1056	80	158	0.563	628	80	93
0.6	30	0.551	3164	80	319	0.554	2104	80	211	0.562	1052	80	104	0.570	626	79	61
0.6	40	0.553	3159	80	238	0.557	2112	80	158	0.566	1046	80	77	0.575	621	79	45
0.6	50	0.555	3164	80	190	0.560	2100	80	125	0.570	1043	79	61	0.580	626	79	36
0.6	70	0.559	3146	80	134	0.564	2108	80	89	0.576	1040	79	43	0.589	618	78	25
0.6	100	0.563	3142	80	93	0.570	2086	79	61	0.584	1051	80	30	0.600	612	78	17
0.6	125	0.567	3147	80	74	0.574	2109	80	49	0.591	1019	78	23	0.609	594	75	13
0.6	150	0.570	3129	80	61	0.578	2081	79	40	0.597	1021	78	19	0.616	610	77	11
0.6	200	0.575	3105	79	45	0.584	2102	80	30	0.607	1020	78	14	0.629	604	77	8
0.6	250	0.580	3132	80	36	0.591	2039	78	23	0.616	1016	77	11	0.644	580	74	6
0.6	300	0.584	3154	80	30	0.597	2042	78	19	0.624	1011	77	9	0.654	589	75	5
0.6	400	0.592	3126	79	22	0.607	2040	78	14	0.644	927	71	6	0.688	495	63	3
0.6	500	0.600	3060	78	17	0.616	2033	77	11	0.654	981	75	5	0.688	619	79	3
0.6	600	0.607	3059	78	14	0.624	2022	77	9	0.668	962	73	4	0.723	521	66	2
0.6	800	0.619	2971	75	10	0.644	1855	71	6	0.688	991	75	3				
DF	CBR	CF	CDL	LOAD	N	CF	CDL	LOAD	N	CF	CDL	LOAD	N	CF	CDL	LOAD	N
A	A	A	A	%	A	A	A	%	A	A	A	%	A	A	A	%	
0.7	20	0.549	3167	80	412	0.552	2110	80	273	0.559	1057	80	135	0.566	634	80	80
0.7	30	0.552	3165	80	273	0.556	2102	80	180	0.564	1054	80	89	0.573	626	79	52
0.7	40	0.555	3155	80	203	0.559	2113	80	135	0.568	1050	80	66	0.578	631	80	39
0.7	50	0.557	3158	80	162	0.562	2105	80	107	0.573	1043	79	52	0.583	633	80	31
0.7	70	0.561	3161	80	115	0.566	2080	79	75	0.579	1050	80	37	0.594	611	78	21
0.7	100	0.566	3130	80	79	0.573	2086	79	52	0.589	1031	79	25	0.607	595	75	14
0.7	125	0.569	3137	80	63	0.577	2070	79	41	0.595	1041	79	20	0.616	593	75	11
0.7	150	0.573	3129	79	52	0.581	2074	79	34	0.602	1011	77	16	0.624	590	75	9
0.7	200	0.579	3080	78	38	0.589	2062	79	25	0.612	1028	78	12	0.636	623	79	7
0.7	250	0.583	3163	80	31	0.595	2083	79	20	0.624	983	75	9	0.654	572	73	5
0.7	300	0.589	3092	79	25	0.602	2023	77	16	0.636	935	71	7	0.668	561	71	4
0.7	400	0.598	3014	77	18	0.612	2056	78	12	0.654	916	70	5	0.688	578	73	3
0.7	500	0.607	2974	76	14	0.624	1966	75	9	0.668	935	71	4	0.723	506	64	2
0.7	600	0.612	3084	78	12	0.636	1870	71	7	0.688	867	66	3	0.723	607	77	2
0.7	800	0.624	3145	80	9	0.654	1831	70	5	0.723	810	62	2				
DF	CBR	CF	CDL	LOAD	N	CF	CDL	LOAD	N	CF	CDL	LOAD	N	CF	CDL	LOAD	N
A	A	A	A	%	A	A	A	%	A	A	A	%	A	A	A	%	
0.8	20	0.550	3168	80	360	0.553	2106	80	238	0.560	1048	80	117	0.568	627	80	69
0.8	30	0.553	3159	80	238	0.557	2112	80	158	0.576	1064	81	77	0.575	621	79	45
0.8	40	0.556	3167	80	178	0.560	2097	80	117	0.571	1042	79	57	0.581	632	80	34
0.8	50	0.558	3147	80	141	0.563	2094	80	93	0.575	1035	79	45	0.588	612	78	26
0.8	70	0.562	3147	80	100	0.568	2099	80	66	0.583	1045	80	32	0.598	603	76	18
0.8	100	0.568	3135	80	69	0.575	2070	79	45	0.592	1042	79	22	0.609	633	80	13
0.8	125	0.572	3146	80	55	0.580	2088	80	36	0.600	1020	78	17	0.619	619	79	10
0.8	150	0.575	3105	79	45	0.584	2102	80	30	0.629	1057	80	14	0.629	604	77	8
0.8	200	0.581	3161	80	34	0.592	2084	79	22	0.654	1046	80	10	0.644	618	78	6
0.8	250	0.588	3058	78	26	0.600	2040	78	17	0.629	1006	77	8	0.668	534	68	4
0.8	300	0.592	3126	79	22	0.607	2040	78	14	0.644	927	71	6	0.688	495	63	3
0.8	400	0.602	3082	78	16	0.619	1981	75	10	0.654	1046	80	5	0.723	463	59	2
0.8	500	0.609	3167	80	13	0.629	2013	77	8	0.688	826	63	3	0.723	578	73	2
0.8	600	0.619	2971	75	10	0.644	1855	71	6	0.688	991	75	3	1.000	480	61	1
0.8	800	0.636	2849	72	7	0.654	2093	80	5	0.723	925	70	2				
DF	CBR	CF	CDL	LOAD	N	CF	CDL	LOAD	N	CF	CDL	LOAD	N	CF	CDL	LOAD	N
A	A	A	A	%	A	A	A	%	A	A	A	%	A	A	A	%	
0.9	20	0.55	3164	80	319	0.554	2104	80	211	0.56	1052	80	104	0.57	626	79	61
0.9	30	0.554	3156	80	211	0.558	2109	80	140	0.568	1043	79	68	0.578	624	79	40
0.9	40	0.557	3168	80	158	0.562	2104	80	104	0.573	1052	80	51	0.584	631	80	30
0.9	50	0.560	3150	80	125	0.565	2110	80	83	0.578	1040	79	40	0.591	612	78	23
0.9	70	0.564	3162	80	89	0.571	2086	79	58	0.586	1034	79	28	0.602	607	77	16
0.9	100	0.570	3129	80	61	0.578	2081	79	40	0.597	1021	78	19	0.616	610	77	11
0.9	125	0.574	3164	80	49	0.583	2099	80	32	0.604	1019	78	15	0.624	632	80	9
0.9	150	0.578	3121	79	40	0.588	2064	79	26	0.612	991	76	12	0.636	601	76	7
0.9	200	0.584	3154	80	30	0.597	2042	78	19	0.624	1011	77	9	0.654	589	75	5
0.9	250	0.591	3058	78	23	0.604	2039	78	15	0.636	1002	76	7	0.668	601	76	4
0.9	300	0.597	3063	78	19	0.612	1983	76	12	0.644	1043	79	6	0.688	557	71	3
0.9	400	0.607	3059	78	14	0.624	2022	77	9	0.668	962	73	4	0.723	521	66	2
0.9	500	0.616	3049	77	11	0.636	2003	76	7	0.688	929	71	3	1.000	450	57	1
0.9	600	0.624	3033	77	9	0.644	2087	79	6	0.723	781	59	2	1.000	540	69	1
0.9	800	0.644	2782	71	6	0.668	1924	73	4	0.723	1041	79	2				



الشركة السعودية للكهرباء

Saudi Electricity Company

**DISTRIBUTION PLANNING STANDARD
Design Guideline Of Underground Low
Voltage Network To Supply Customers**

**DISTRIBUTION PLANNING STANDARD
DPS-02**

ISSUE DATE:

September, 2015

REVISION

02

Page 61 of 78

A9. TABLE FOR NO. OF METERS CAN BE SUPPLIED (IN HAJJ AREA)

This Table shows No. of Meters can be supplied by Substation and Distribution Pillar and LV Cables in Hajj Area for different Nominal Voltages (400 , 380 , 220 V) and for different CB Ratings (20 ,30 ,40 ,50 ,70, 100 , 125 , 150 , 200 , 250, 300 , 400 , 500 , 600 , 800) A.

DP 400 A capacity =310 A					300 mm ² Cable capacity =310 A					185 mm ² Cable capacity =230 A					70 mm ² Cable capacity =135 A				
DF	CBR	CF	CDL	LOAD N	CF	CDL	LOAD N	CF	CDL	LOAD N	CF	CDL	LOAD N	CF	CDL	LOAD N			
A		A	%		A	%		A	%		A	%		A	%				
0.9	20	1.00	234	75	13	1.00	234	75	13	1.00	180	78	10	1.00	108	80	6		
0.9	30	1.00	243	78	9	1.00	243	78	9	1.00	162	70	6	1.00	108	80	4		
0.9	40	1.00	216	70	6	1.00	216	70	6	1.00	180	78	5	1.00	108	80	3		
0.9	50	1.00	225	73	5	1.00	225	73	5	1.00	180	78	4	1.00	90	67	2		
0.9	70	1.00	189	61	3	1.00	189	61	3	1.00	126	55	2	1.00	63	47	1		
0.9	100	1.00	180	58	2	1.00	180	58	2	1.00	180	78	2	1.00	90	67	1		
0.9	125	1.00	225	73	2	1.00	225	73	2	1.00	112.5	49	1						
0.9	150	1.00	135	44	1	1.00	135	44	1	1.00	135	59	1						
0.9	200	1.00	180	58	1	1.00	180	58	1	1.00	180	78	1						
0.9	250	1.00	225	73	1	1.00	225	73	1										
0.9	300																		
0.9	400																		
SS 1500 KVA 400V					SS 1000 KVA 400V					SS 500 KVA 400V					SS 300 KVA 400V				
DF	CBR	CF	CDL	LOAD N	CF	CDL	LOAD N	CF	CDL	LOAD N	CF	CDL	LOAD N	CF	CDL	LOAD N			
A		A	%		A	%		A	%		A	%		A	%				
0.9	20	1.00	1728	80	96	1.00	1152	80	64	1.00	576	80	32	1.00	342	79	19		
0.9	30	1.00	1728	80	64	1.00	1161	80	43	1.00	567	79	21	1.00	324	75	12		
0.9	40	1.00	1728	80	48	1.00	1152	80	32	1.00	576	80	16	1.00	324	75	9		
0.9	50	1.00	1710	79	38	1.00	1125	78	25	1.00	540	75	12	1.00	315	73	7		
0.9	70	1.00	1701	79	27	1.00	1134	79	18	1.00	567	79	9	1.00	315	73	5		
0.9	100	1.00	1710	79	19	1.00	1080	75	12	1.00	540	75	6	1.00	270	62	3		
0.9	125	1.00	1688	78	15	1.00	1125	78	10	1.00	563	78	5	1.00	337.5	78	3		
0.9	150	1.00	1620	75	12	1.00	1080	75	8	1.00	540	75	4	1.00	270	62	2		
0.9	200	1.00	1620	75	9	1.00	1080	75	6	1.00	540	75	3	1.00	180	42	1		
0.9	250	1.00	1575	73	7	1.00	1125	78	5	1.00	450	62	2	1.00	225	52	1		
0.9	300	1.00	1620	75	6	1.00	1080	75	4	1.00	540	75	2	1.00	270	62	1		
0.9	400	1.00	1440	67	4	1.00	1080	75	3	1.00	360	50	1						
0.9	500	1.00	1350	62	3	1.00	900	62	2	1.00	450	62	1						
0.9	600	1.00	1620	75	3	1.00	1080	75	2	1.00	540	75	1						
0.9	800	1.00	1440	67	2	1.00	720	50	1										
SS 1500 KVA 380 V					SS 1000 KVA 380 V					SS 500 KVA 380 V					SS 300 KVA 380 V				
DF	CBR	CF	CDL	LOAD N	CF	CDL	LOAD N	CF	CDL	LOAD N	CF	CDL	LOAD N	CF	CDL	LOAD N			
A		A	%		A	%		A	%		A	%		A	%				
0.9	20	1.00	1818	80	101	1.00	1206	79	67	1.00	594	78	33	1.00	360	79	20		
0.9	30	1.00	1809	79	67	1.00	1215	80	45	1.00	594	78	22	1.00	351	77	13		
0.9	40	1.00	1800	79	50	1.00	1188	78	33	1.00	576	76	16	1.00	360	79	10		
0.9	50	1.00	1800	79	40	1.00	1215	80	27	1.00	585	77	13	1.00	360	79	8		
0.9	70	1.00	1827	80	29	1.00	1197	79	19	1.00	567	75	9	1.00	315	69	5		
0.9	100	1.00	1800	79	20	1.00	1170	77	13	1.00	540	71	6	1.00	360	79	4		
0.9	125	1.00	1800	79	16	1.00	1125	74	10	1.00	563	74	5	1.00	337.5	74	3		
0.9	150	1.00	1755	77	13	1.00	1215	80	9	1.00	540	71	4	1.00	270	59	2		
0.9	200	1.00	1800	79	10	1.00	1080	71	6	1.00	540	71	3	1.00	360	79	2		
0.9	250	1.00	1800	79	8	1.00	1125	74	5	1.00	450	59	2	1.00	225	49	1		
0.9	300	1.00	1620	71	6	1.00	1080	71	4	1.00	540	71	2	1.00	270	59	1		
0.9	400	1.00	1800	79	5	1.00	1080	71	3	1.00	360	47	1	1.00	360	79	1		
0.9	500	1.00	1800	79	4	1.00	900	59	2	1.00	450	59	1						
0.9	600	1.00	1620	71	3	1.00	1080	71	2	1.00	540	71	1						
0.9	800	1.00	1440	63	2	1.00	720	47	1										
SS 1500 KVA 220 V					SS 1000 KVA 220 V					SS 500 KVA 220 V					SS 300 KVA 220 V				
DF	CBR	CF	CDL	LOAD N	CF	CDL	LOAD N	CF	CDL	LOAD N	CF	CDL	LOAD N	CF	CDL	LOAD N			
A		A	%		A	%		A	%		A	%		A	%				
0.9	20	1.00	3168	80	176	1.00	2106	80	117	1.00	1044	80	58	1.00	630	80	35		
0.9	30	1.00	3159	80	117	1.00	2106	80	78	1.00	1053	80	39	1.00	621	79	23		
0.9	40	1.00	3168	80	88	1.00	2088	80	58	1.00	1044	80	29	1.00	612	78	17		
0.9	50	1.00	3150	80	70	1.00	2070	79	46	1.00	1035	79	23	1.00	630	80	14		
0.9	70	1.00	3150	80	50	1.00	2079	79	33	1.00	1008	77	16	1.00	630	80	10		
0.9	100	1.00	3150	80	35	1.00	2070	79	23	1.00	990	75	11	1.00	630	80	7		
0.9	125	1.00	3150	80	28	1.00	2025	77	18	1.00	1013	77	9	1.00	563	71	5		
0.9	150	1.00	3105	79	23	1.00	2025	77	15	1.00	945	72	7	1.00	540	69	4		
0.9	200	1.00	3060	78	17	1.00	1980	75	11	1.00	900	69	5	1.00	540	69	3		
0.9	250	1.00	3150	80	14	1.00	1575	60	7	1.00	900	69	4	1.00	450	57	2		
0.9	300	1.00	2970	75	11	1.00	1890	72	7	1.00	810	62	3	1.00	540	69	2		
0.9	400	1.00	2880	73	8	1.00	1800	69	5	1.00	720	55	2	1.00	360	46	1		
0.9	500	1.00	3150	80	7	1.00	1800	69	4	1.00	900	69	2	1.00	450	57	1		
0.9	600	1.00	2700	69	5	1.00	1620	62	3	1.00	540	41	1	1.00	540	69	1		
0.9	800	1.00	2880	73	4	1.00	1440	55	2	1.00	720	55	1						


A10. TABLE FOR NO. OF METERS CAN BE SUPPLIED (IN RANDOM AREA)

This Table shows No. of Meters can be supplied by Substation and Distribution Pillar and Cables in Random Area for different Nominal Voltages (400 , 380 , 220 V) and for different CB Ratings (20 ,30 ,40 ,50 ,70 ,100 , 125 , 150 , 200 , 250, 300 , 400 , 500 , 600 , 800) A.

DP 400 A capacity =310 A				300 mm ² Cable capacity =310 A				185 mm ² Cable capacity =230 A				70 mm ² Cable capacity =135 A					
DF	CBR	CF	CDL LOAD N	CF	CDL LOAD N	CF	CDL LOAD N	CF	CDL LOAD N	CF	CDL LOAD N	CF	CDL LOAD N	CF	CDL LOAD N		
		A	%	A	%	A	%	A	%	A	%	A	%	A	%		
1	20	0.80	240	77	15	0.80	240	77	15	0.80	176	77	11	0.80	96	71	6
1	30	0.80	240	77	10	0.80	240	77	10	0.80	168	73	7	0.80	96	71	4
1	40	0.80	224	72	7	0.80	224	72	7	0.80	160	70	5	0.80	96	71	3
1	50	0.80	240	77	6	0.80	240	77	6	0.80	160	70	4	0.80	80	59	2
1	70	0.80	224	72	4	0.80	224	72	4	0.80	168	73	3	0.80	56	41	1
1	100	0.80	240	77	3	0.80	240	77	3	0.80	160	70	2	0.80	80	59	1
1	125	0.80	200	65	2	0.80	200	65	2	0.80	100	43	1	0.80	100	74	1
1	150	0.80	240	77	2	0.80	240	77	2	0.80	120	52	1				
1	200	0.80	160	52	1	0.80	160	52	1	0.80	160	70	1				
1	250	0.80	200	65	1	0.80	200	65	1								
1	300	0.80	240	77	1	0.80	240	77	1								
1	400																
SS 1500 KVA 400V				SS 1000 KVA 400V				SS 500 KVA 400V				SS 300 KVA 400V					
DF	CBR	CF	CDL LOAD N	CF	CDL LOAD N	CF	CDL LOAD N	CF	CDL LOAD N	CF	CDL LOAD N	CF	CDL LOAD N	CF	CDL LOAD N		
		A	%	A	%	A	%	A	%	A	%	A	%	A	%		
1	20	0.80	1728	80	108	0.80	1152	80	72	0.80	576	80	36	0.80	336	78	21
1	30	0.80	1776	82	74	0.80	1152	80	48	0.80	576	80	24	0.80	336	78	14
1	40	0.80	1728	80	54	0.80	1152	80	36	0.80	576	80	18	0.80	320	74	10
1	50	0.80	1720	79	43	0.80	1160	80	29	0.80	560	78	14	0.80	320	74	8
1	70	0.80	1736	80	31	0.80	1120	78	20	0.80	560	78	10	0.80	336	78	6
1	100	0.80	1680	78	21	0.80	1120	78	14	0.80	560	78	7	0.80	320	74	4
1	125	0.80	1700	79	17	0.80	1100	76	11	0.80	500	69	5	0.80	300	69	3
1	150	0.80	1680	78	14	0.80	1080	75	9	0.80	480	66	4	0.80	240	55	2
1	200	0.80	1600	74	10	0.80	1120	78	7	0.80	480	66	3	0.80	320	74	2
1	250	0.80	1600	74	8	0.80	1000	69	5	0.80	400	55	2	0.80	200	46	1
1	300	0.80	1680	78	7	0.80	960	67	4	0.80	480	66	2	0.80	240	55	1
1	400	0.80	1600	74	5	0.80	960	67	3	0.80	320	44	1	0.80	320	74	1
1	500	0.80	1600	74	4	0.80	800	55	2	0.80	400	55	1				
1	600	0.80	1440	67	3	0.80	960	67	2	0.80	480	66	1				
1	800	0.80	1280	59	2	0.80	640	44	1								
SS 1500 KVA 380 V				SS 1000 KVA 380 V				SS 500 KVA 380 V				SS 300 KVA 380 V					
DF	CBR	CF	CDL LOAD N	CF	CDL LOAD N	CF	CDL LOAD N	CF	CDL LOAD N	CF	CDL LOAD N	CF	CDL LOAD N	CF	CDL LOAD N		
		A	%	A	%	A	%	A	%	A	%	A	%	A	%		
1	20	0.80	1824	80	114	0.80	1216	80	76	0.80	608	80	38	0.80	352	77	22
1	30	0.80	1824	80	76	0.80	1200	79	50	0.80	600	79	25	0.80	360	79	15
1	40	0.80	1824	80	57	0.80	1216	80	38	0.80	608	80	19	0.80	352	77	11
1	50	0.80	1800	79	45	0.80	1200	79	30	0.80	600	79	15	0.80	360	79	9
1	70	0.80	1792	79	32	0.80	1176	77	21	0.80	560	74	10	0.80	336	74	6
1	100	0.80	1760	77	22	0.80	1200	79	15	0.80	560	74	7	0.80	320	70	4
1	125	0.80	1800	79	18	0.80	1200	79	12	0.80	600	79	6	0.80	300	66	3
1	150	0.80	1800	79	15	0.80	1200	79	10	0.80	600	79	5	0.80	360	79	3
1	200	0.80	1760	77	11	0.80	1280	84	8	0.80	480	63	3	0.80	320	70	2
1	250	0.80	1800	79	9	0.80	1200	79	6	0.80	600	79	3	0.80	200	44	1
1	300	0.80	1680	74	7	0.80	1200	79	5	0.80	480	63	2	0.80	240	53	1
1	400	0.80	1600	70	5	0.80	960	63	3	0.80	320	42	1	0.80	320	70	1
1	500	0.80	1600	70	4	0.80	1200	79	3	0.80	400	53	1				
1	600	0.80	1440	63	3	0.80	960	63	2	0.80	480	63	1				
1	800	0.80	1280	56	2	0.80	640	42	1								
SS 1500 KVA 220 V				SS 1000 KVA 220 V				SS 500 KVA 220 V				SS 300 KVA 220 V					
DF	CBR	CF	CDL LOAD N	CF	CDL LOAD N	CF	CDL LOAD N	CF	CDL LOAD N	CF	CDL LOAD N	CF	CDL LOAD N	CF	CDL LOAD N		
		A	%	A	%	A	%	A	%	A	%	A	%	A	%		
1	20	0.80	3168	80	198	0.80	2112	80	132	0.80	1056	80	66	0.80	624	79	39
1	30	0.80	3168	80	132	0.80	2112	80	88	0.80	1056	80	44	0.80	624	79	26
1	40	0.80	3168	80	99	0.80	2112	80	66	0.80	1056	80	33	0.80	608	77	19
1	50	0.80	3160	80	79	0.80	2080	79	52	0.80	1040	79	26	0.80	600	76	15
1	70	0.80	3136	80	56	0.80	2072	79	37	0.80	1008	77	18	0.80	616	78	11
1	100	0.80	3120	79	39	0.80	2080	79	26	0.80	1040	79	13	0.80	560	71	7
1	125	0.80	3100	79	31	0.80	2100	80	21	0.80	1000	76	10	0.80	600	76	6
1	150	0.80	3120	79	26	0.80	2040	78	17	0.80	960	73	8	0.80	600	76	5
1	200	0.80	3040	77	19	0.80	2080	79	13	0.80	960	73	6	0.80	480	61	3
1	250	0.80	3000	76	15	0.80	2000	76	10	0.80	1000	76	5	0.80	600	76	3
1	300	0.80	3120	79	13	0.80	1920	73	8	0.80	960	73	4	0.80	480	61	2
1	400	0.80	2880	73	9	0.80	1920	73	6	0.80	960	73	3	0.80	320	41	1
1	500	0.80	2800	71	7	0.80	2000	76	5	0.80	800	61	2	0.80	400	51	1
1	600	0.80	2880	73	6	0.80	1920	73	4	0.80	960	73	2	0.80	480	61	1
1	800	0.80	2560	65	4	0.80	1920	73	3	0.80	640	49	1				



A11. TABLE FOR NO. OF METERS CAN BE SUPPLIED (FOR COMMERCIAL CENTER)

This Table shows No. of Meters can be supplied by Substation and Distribution Pillar and LV Cables in Commercial Center for different Voltages (400 , 380 , 220 V) and for different CB Ratings (30 , 50 ,70, 100 , 150 , 200 , 250, 300 , 400 , 500 , 600 , 800) A.

		DP 400 A capacity =310 A					300 mm ² Cable capacity =310 A					185 mm ² Cable capacity =230 A					70 mm ² Cable capacity =135 A				
DF	CBR	CF	CDL	LOAD	N		CF	CDL	LOAD	N		CF	CDL	LOAD	N		CF	CDL	LOAD	N	
	A		A	%				A	%				A	%			A	%			
0.7	30	1.00	231	75	11		1.00	231	75	11		1.00	168	73	8		1.00	105	78	5	
0.7	50	1.00	245	79	7		1.00	245	79	7		1.00	175	76	5		1.00	105	78	3	
0.7	70	1.00	245	79	5		1.00	245	79	5		1.00	147	64	3		1.00	98	73	2	
0.7	100	1.00	210	68	3		1.00	210	68	3		1.00	140	61	2		1.00	70	52	1	
0.7	150	1.00	210	68	2		1.00	210	68	2		1.00	105	46	1						
0.7	200	1.00	140	45	1		1.00	140	45	1		1.00	140	61	1						
0.7	250	1.00	175	56	1		1.00	175	56	1											
0.7	300	1.00	210	68	1		1.00	210	68	1											
0.7	400																				
	SS 1500 KVA 400V						SS 1000 KVA 400V					SS 500 KVA 400V					SS 300 KVA 400V				
DF	CBR	CF	CDL	LOAD	N		CF	CDL	LOAD	N		CF	CDL	LOAD	N		CF	CDL	LOAD	N	
	A		A	%				A	%				A	%			A	%			
0.7	30	1.00	1722	80	82		1.00	1155	80	55		1.00	567	79	27		1.00	336	78	16	
0.7	50	1.00	1715	79	49		1.00	1155	80	33		1.00	560	78	16		1.00	315	73	9	
0.7	70	1.00	1715	79	35		1.00	1127	78	23		1.00	539	75	11		1.00	343	79	7	
0.7	100	1.00	1680	78	24		1.00	1120	78	16		1.00	560	78	8		1.00	280	65	4	
0.7	150	1.00	1680	78	16		1.00	1155	80	11		1.00	525	73	5		1.00	315	73	3	
0.7	200	1.00	1680	78	12		1.00	1120	78	8		1.00	560	78	4		1.00	280	65	2	
0.7	250	1.00	1575	73	9		1.00	1050	73	6		1.00	525	73	3		1.00	175	40	1	
0.7	300	1.00	1680	78	8		1.00	1050	73	5		1.00	420	58	2		1.00	210	48	1	
0.7	400	1.00	1680	78	6		1.00	1120	78	4		1.00	560	78	2		1.00	280	65	1	
0.7	500	1.00	1400	65	4		1.00	1050	73	3		1.00	350	48	1						
0.7	600	1.00	1680	78	4		1.00	840	58	2		1.00	420	58	1						
0.7	800	1.00	1680	78	3		1.00	1120	78	2											
	SS 1500 KVA 380 V						SS 1000 KVA 380 V					SS 500 KVA 380 V					SS 300 KVA 380 V				
DF	CBR	CF	CDL	LOAD	N		CF	CDL	LOAD	N		CF	CDL	LOAD	N		CF	CDL	LOAD	N	
	A		A	%				A	%				A	%			A	%			
0.7	30	1.00	1827	80	87		1.00	1218	80	58		1.00	609	80	29		1.00	357	78	17	
0.7	50	1.00	1820	80	52		1.00	1190	78	34		1.00	595	78	17		1.00	350	77	10	
0.7	70	1.00	1813	80	37		1.00	1176	77	24		1.00	588	77	12		1.00	343	75	7	
0.7	100	1.00	1820	80	26		1.00	1190	78	17		1.00	560	74	8		1.00	350	77	5	
0.7	150	1.00	1785	78	17		1.00	1155	76	11		1.00	525	69	5		1.00	315	69	3	
0.7	200	1.00	1820	80	13		1.00	1120	74	8		1.00	560	74	4		1.00	280	61	2	
0.7	250	1.00	1750	77	10		1.00	1050	69	6		1.00	525	69	3		1.00	350	77	2	
0.7	300	1.00	1680	74	8		1.00	1050	69	5		1.00	420	55	2		1.00	210	46	1	
0.7	400	1.00	1680	74	6		1.00	1120	74	4		1.00	560	74	2		1.00	280	61	1	
0.7	500	1.00	1750	77	5		1.00	1050	69	3		1.00	350	46	1						
0.7	600	1.00	1680	74	4		1.00	840	55	2		1.00	420	55	1						
0.7	800	1.00	1680	74	3		1.00	1120	74	2											
	SS 1500 KVA 220 V						SS 1000 KVA 220 V					SS 500 KVA 220 V					SS 300 KVA 220 V				
DF	CBR	CF	CDL	LOAD	N		CF	CDL	LOAD	N		CF	CDL	LOAD	N		CF	CDL	LOAD	N	
	A		A	%				A	%				A	%			A	%			
0.7	30	1.00	3150	80	150		1.00	2100	80	100		1.00	1050	80	50		1.00	630	80	30	
0.7	50	1.00	3150	80	90		1.00	2100	80	60		1.00	1050	80	30		1.00	630	80	18	
0.7	70	1.00	3136	80	64		1.00	2107	80	43		1.00	1029	78	21		1.00	588	75	12	
0.7	100	1.00	3150	80	45		1.00	2100	80	30		1.00	1050	80	15		1.00	630	80	9	
0.7	150	1.00	3150	80	30		1.00	2100	80	20		1.00	1050	80	10		1.00	630	80	6	
0.7	200	1.00	3080	78	22		1.00	2100	80	15		1.00	980	75	7		1.00	560	71	4	
0.7	250	1.00	3150	80	18		1.00	2100	80	12		1.00	1050	80	6		1.00	525	67	3	
0.7	300	1.00	3150	80	15		1.00	2100	80	10		1.00	1050	80	5		1.00	630	80	3	
0.7	400	1.00	3080	78	11		1.00	1960	75	7		1.00	840	64	3		1.00	560	71	2	
0.7	500	1.00	3150	80	9		1.00	2100	80	6		1.00	1050	80	3		1.00	350	44	1	
0.7	600	1.00	2940	75	7		1.00	2100	80	5		1.00	840	64	2		1.00	420	53	1	
0.7	800	1.00	2800	71	5		1.00	1680	64	3		1.00	560	43	1						

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		ISSUE DATE:
	September, 2015	REVISION
		02

Page 64 of 78

A12. TABLE FOR MAX LENGTHS WITHIN (5%) VOLTAGE DROP

This Table shows the Max Lengths (m) can be achieved within (5%) Voltage Drop for different Coincident Demand Load (KVA) and for different Nominal Voltages (400 , 380 , 220 V) and for different LV Cables' Sizes (300 , 185 , 70 mm²).

VD % =	5							PF =	0.85 Lag
Nominal Voltage	400 V	400 V	400 V	380 V	380 V	380 V	220 V	220 V	220 V
Cable Size	300 mm ²	185 mm ²	70 mm ²	300 mm ²	185 mm ²	70 mm ²	300 mm ²	185 mm ²	70 mm ²
K Constant	10132	7040	3003	9144	6353	2710	3065	2129	908
CDL	Length	Length	Length	Length	Length	Length	Length	Length	Length
(KVA)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)
5	560	560	560	530	530	530	310	310	310
10	560	560	560	530	530	530	310	310	310
15	560	560	560	530	530	530	310	310	303
20	560	560	560	530	530	530	310	310	227
25	560	560	560	530	530	530	310	310	182
30	560	560	500	530	530	452	310	310	151
35	560	560	429	530	530	387	310	304	130
40	560	560	375	530	530	339	310	266	114
45	560	560	334	530	530	301	310	237	
50	560	560	300	530	530	271	307	213	
55	560	560	273	530	530	246	279	194	
60	560	560	250	530	529	226	255	177	
65	560	542	231	530	489	208	236	164	
70	560	503	214	530	454	194	219	152	
75	560	469	200	530	424		204		
80	560	440		530	397		192		
85	560	414		530	374		180		
90	560	391		508	353		170		
95	533	371		481	334		161		
100	507	352		457	318				
105	482	335		435	303				
110	461	320		416	289				
115	441	306		398	276				
120	422	293		381	265				
125	405	282		366					
130	390			352					
135	375			339					
140	362			327					
145	349			315					
150	338			305					
155	327			295					
160	317			286					
165	307								
170	298								
Firm Capacity (KVA)	172	127	75	163	121	71	95	70	41

**A13. TABLE FOR MAX LENGTHS WITHIN (3.5%) VOLTAGE DROP**

This Table shows the Max Lengths (m) can be achieved within (3.5%) Voltage Drop for different Coincident Demand Load (KVA) and for different Nominal Voltages (400 , 380 , 220 V) and for different LV Cables' Sizes (300 , 185 , 70 mm²).

VD % =	3.5								PF =	0.85 Lag
Nominal Voltage	400 V	400 V	400 V	380 V	380 V	380 V	220 V	220 V	220 V	
Cable Size	300 mm ²	185 mm ²	70 mm ²	300 mm ²	185 mm ²	70 mm ²	300 mm ²	185 mm ²	70 mm ²	
K Constant	10132	7040	3003	9144	6353	2710	3065	2129	908	
CDL	Length	Length	Length	Length	Length	Length	Length	Length	Length	
(KVA)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	
5	560	560	560	530	530	530	310	310	310	
10	560	560	560	530	530	530	310	310	310	
15	560	560	560	530	530	530	310	310	212	
20	560	560	525	530	530	474	310	310	159	
25	560	560	420	530	530	379	310	298	127	
30	560	560	350	530	530	316	310	248	106	
35	560	560	300	530	530	271	307	213	91	
40	560	560	263	530	530	237	268	186	79	
45	560	548	234	530	494	211	238	166		
50	560	493	210	530	445	190	215	149		
55	560	448	191	530	404	172	195	136		
60	560	411	175	530	371	158	179	124		
65	546	379	162	492	342	146	165	115		
70	507	352	150	457	318	135	153	106		
75	473	329	140	427	296		143			
80	443	308		400	278		134			
85	417	290		377	262		126			
90	394	274		356	247		119			
95	373	259		337	234		113			
100	355	246		320	222					
105	338	235		305	212					
110	322	224		291	202					
115	308	214		278	193					
120	296	205		267	185					
125	284	197		256						
130	273			246						
135	263			237						
140	253			229						
145	245			221						
150	236			213						
155	229			206						
160	222			200						
165	215									
170	209									
Firm Capacity (KVA)	172	127	75	163	121	71	95	70	41	

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		ISSUE DATE:
	September, 2015	REVISION
		02

A14. TABLE FOR MAX LENGTHS WITHIN (1.5%) VOLTAGE DROP

This Table shows the Max Lengths (m) can be achieved within (1.5%) Voltage Drop for different Coincident Demand Load (KVA) and for different Nominal Voltages (400 , 380 , 220 V) and for different LV Cables' Sizes (300 , 185 , 70 mm²).

VD % =	1.5							PF	0.85 Lag
Nominal Voltage	400 V	400 V	400 V	380 V	380 V	380 V	220 V	220 V	220 V
Cable Size	300 mm ²	185 mm ²	70 mm ²	300 mm ²	185 mm ²	70 mm ²	300 mm ²	185 mm ²	70 mm ²
K Constant	10132	7040	3003	9144	6353	2710	3065	2129	908
CDL	Length	Length	Length	Length	Length	Length	Length	Length	Length
(KVA)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)
5	560	560	560	530	530	530	310	310	272
10	560	560	450	530	530	406	310	310	136
15	560	560	300	530	530	271	307	213	91
20	560	528	225	530	476	203	230	160	68
25	560	422	180	530	381	163	184	128	54
30	507	352	150	457	318	135	153	106	45
35	434	302	129	392	272	116	131	91	39
40	380	264	113	343	238	102	115	80	34
45	338	235	100	305	212	90	102	71	
50	304	211	90	274	191	81	92	64	
55	276	192	82	249	173	74	84	58	
60	253	176	75	229	159	68	77	53	
65	234	162	69	211	147	63	71	49	
70	217	151	64	196	136	58	66	46	
75	203	141	60	183	127		61		
80	190	132		171	119		57		
85	179	124		161	112		54		
90	169	117		152	106		51		
95	160	111		144	100		48		
100	152	106		137	95				
105	145	101		131	91				
110	138	96		125	87				
115	132	92		119	83				
120	127	88		114	79				
125	122	84		110					
130	117			106					
135	113			102					
140	109			98					
145	105			95					
150	101			91					
155	98			88					
160	95			86					
165	92								
170	89								
Firm Capacity (KVA)	172	127	75	163	121	71	95	70	41



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Saudi Electricity Company

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Design Guideline Of Underground Low
Voltage Network To Supply Customers

DISTRIBUTION PLANNING STANDARD
DPS-02

ISSUE DATE:	REVISION
September, 2015	02
	Page 67 of 78

A15. TABLE FOR VOLTAGE DROP (%) IN (400 V) WITH (300 MM² CABLE)

This Table shows the Voltage Drop (%) in (400 V) LV Network with LV Cable size (300 mm²) for different Coincident Demand Load (KVA) with different Cables' Length (m).

Nominal Voltage 400 V	Cable Size 300 mm ²	K Constant 10132	PF = 0.85 Lag	Voltage Drop (%)																								
				Length (m)	20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380	400	420	440	460	480
CDL (KVA)																												
5	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.10	0.11	0.12	0.13	0.14	0.15	0.16	0.17	0.18	0.19	0.20	0.21	0.22	0.23	0.24	0.25			
10	0.02	0.04	0.06	0.08	0.10	0.12	0.14	0.16	0.18	0.20	0.22	0.24	0.26	0.28	0.30	0.32	0.34	0.36	0.38	0.39	0.41	0.43	0.45	0.47	0.49			
15	0.03	0.06	0.09	0.12	0.15	0.18	0.21	0.24	0.27	0.30	0.33	0.36	0.38	0.41	0.44	0.47	0.50	0.53	0.56	0.59	0.62	0.65	0.68	0.71	0.74			
20	0.04	0.08	0.12	0.16	0.20	0.24	0.28	0.32	0.36	0.43	0.47	0.51	0.55	0.59	0.63	0.67	0.71	0.75	0.79	0.83	0.87	0.91	0.95	0.99				
25	0.05	0.10	0.15	0.20	0.25	0.30	0.35	0.39	0.44	0.49	0.54	0.59	0.64	0.69	0.74	0.79	0.84	0.89	0.94	0.99	1.04	1.09	1.13	1.18	1.23			
30	0.06	0.12	0.18	0.24	0.30	0.36	0.41	0.47	0.53	0.59	0.65	0.71	0.77	0.83	0.89	0.95	1.01	1.07	1.13	1.18	1.24	1.30	1.36	1.42	1.48			
35	0.07	0.14	0.21	0.28	0.35	0.41	0.48	0.55	0.62	0.69	0.76	0.83	0.90	0.97	1.04	1.11	1.17	1.24	1.31	1.38	1.45	1.52	1.59	1.66	1.73			
40	0.08	0.16	0.24	0.32	0.39	0.47	0.55	0.63	0.71	0.79	0.87	0.95	1.03	1.11	1.18	1.26	1.34	1.42	1.50	1.58	1.66	1.74	1.82	1.89	1.97			
45	0.09	0.18	0.27	0.36	0.44	0.53	0.62	0.71	0.80	0.89	0.98	1.07	1.15	1.24	1.33	1.42	1.51	1.60	1.69	1.78	1.87	1.95	2.04	2.13	2.22			
50	0.10	0.20	0.30	0.39	0.49	0.59	0.69	0.79	0.89	0.99	1.09	1.18	1.28	1.38	1.48	1.58	1.68	1.78	1.88	1.97	2.07	2.17	2.27	2.37	2.47			
55	0.11	0.22	0.33	0.43	0.54	0.65	0.76	0.87	0.98	1.09	1.19	1.30	1.41	1.52	1.63	1.74	1.85	1.95	2.06	2.17	2.28	2.39	2.50	2.61	2.71			
60	0.12	0.24	0.36	0.47	0.59	0.71	0.83	0.95	1.07	1.18	1.30	1.42	1.54	1.66	1.78	1.89	2.01	2.13	2.25	2.37	2.49	2.61	2.72	2.84	2.96			
65	0.13	0.26	0.38	0.51	0.64	0.77	0.90	1.03	1.15	1.28	1.41	1.54	1.67	1.80	1.92	2.05	2.18	2.31	2.44	2.57	2.69	2.82	2.95	3.08	3.21			
70	0.14	0.28	0.41	0.55	0.69	0.83	0.97	1.11	1.24	1.38	1.52	1.66	1.80	1.93	2.07	2.21	2.35	2.49	2.63	2.76	2.90	3.04	3.18	3.32	3.45			
75	0.15	0.30	0.44	0.59	0.74	0.89	1.04	1.18	1.33	1.48	1.63	1.78	1.92	2.07	2.22	2.37	2.52	2.66	2.81	2.96	3.11	3.26	3.40	3.55	3.70			
80	0.16	0.32	0.47	0.63	0.79	0.95	1.11	1.26	1.42	1.58	1.74	1.89	2.05	2.21	2.37	2.53	2.68	2.84	3.00	3.16	3.32	3.47	3.63	3.79	3.95			
85	0.17	0.34	0.50	0.67	0.84	1.01	1.17	1.34	1.51	1.68	1.85	2.01	2.18	2.35	2.52	2.68	2.85	3.02	3.19	3.36	3.52	3.69	3.86	4.03	4.19			
90	0.18	0.36	0.53	0.71	0.89	1.07	1.24	1.42	1.60	1.78	1.95	2.13	2.31	2.49	2.66	2.84	3.02	3.20	3.38	3.55	3.73	3.91	4.09	4.26	4.44			
95	0.19	0.38	0.56	0.75	0.94	1.13	1.31	1.50	1.69	1.88	2.06	2.25	2.44	2.63	2.81	3.00	3.19	3.38	3.56	3.75	3.94	4.13	4.31	4.50	4.69			
100	0.20	0.39	0.59	0.79	0.99	1.18	1.38	1.58	1.78	1.97	2.17	2.37	2.57	2.76	2.96	3.16	3.36	3.55	3.75	3.95	4.15	4.34	4.54	4.74	4.93			
105	0.21	0.41	0.62	0.83	1.04	1.24	1.45	1.66	1.87	2.07	2.28	2.49	2.69	2.90	3.11	3.32	3.52	3.73	3.94	4.15	4.35	4.56	4.77	4.97	5.18			
110	0.22	0.43	0.65	0.87	1.09	1.30	1.52	1.74	1.95	2.17	2.39	2.61	2.82	3.04	3.26	3.47	3.69	3.91	4.13	4.34	4.56	4.78	4.99	5.21	5.43			
115	0.23	0.45	0.68	0.91	1.13	1.36	1.59	1.82	2.04	2.27	2.50	2.72	2.95	3.18	3.40	3.63	3.86	4.09	4.31	4.54	4.77	4.99	5.22	5.45	5.67			
120	0.24	0.47	0.71	0.95	1.18	1.42	1.66	1.89	2.13	2.37	2.61	2.84	3.08	3.32	3.55	3.79	4.03	4.26	4.50	4.74	4.97	5.21	5.45	5.68	5.92			
125	0.25	0.49	0.74	0.99	1.23	1.48	1.73	1.97	2.22	2.47	2.71	2.96	3.21	3.45	3.70	3.95	4.19	4.44	4.69	4.93	5.18	5.43	5.67	5.92	6.17			
130	0.26	0.51	0.77	1.03	1.28	1.54	1.80	2.05	2.31	2.57	2.82	3.08	3.34	3.59	3.85	4.11	4.36	4.62	4.88	5.13	5.39	5.66	5.90	6.16	6.42			
135	0.27	0.53	0.80	1.07	1.33	1.60	1.87	2.13	2.40	2.66	2.93	3.20	3.46	3.73	4.00	4.26	4.53	4.80	5.06	5.33	5.60	5.86	6.13	6.40	6.66			
140	0.28	0.55	0.83	1.11	1.38	1.66	1.93	2.21	2.49	2.76	3.04	3.32	3.59	3.87	4.15	4.42	4.70	4.97	5.25	5.53	5.80	6.08	6.36	6.63	6.91			
145	0.29	0.57	0.86	1.14	1.43	1.72	2.00	2.29	2.58	2.86	3.15	3.43	3.72	4.01	4.29	4.58	4.87	5.15	5.44	5.72	6.01	6.30	6.58	6.87	7.16			
150	0.30	0.59	0.89	1.18	1.48	1.78	2.07	2.37	2.66	2.96	3.26	3.55	3.85	4.15	4.44	4.74	5.03	5.33	5.63	5.92	6.22	6.51	6.81	7.11	7.40			
155	0.31	0.61	0.92	1.22	1.53	1.84	2.14	2.45	2.75	3.06	3.37	3.67	3.98	4.28	4.59	4.90	5.20	5.51	5.81	6.12	6.42	6.73	7.04	7.34	7.65			
160	0.32	0.63	0.95	1.26	1.58	1.89	2.21	2.53	2.84	3.16	3.47	3.79	4.11	4.42	4.74	5.05	5.37	5.68	6.00	6.32	6.63	6.95	7.26	7.58	7.90			
165	0.33	0.65	0.98	1.30	1.63	1.95	2.28	2.61	2.93	3.26	3.58	3.91	4.23	4.56	4.89	5.21	5.54	5.86	6.19	6.51	6.84	7.17	7.49	7.82	8.14			
170	0.34	0.67	1.01	1.34	1.68	2.01	2.35	2.68	3.02	3.36	3.69	4.03	4.36	4.70	5.03	5.37	5.70	6.04	6.38	6.71	7.05	7.38	7.72	8.05	8.39			



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Design Guideline Of Underground Low
Voltage Network To Supply Customers

DISTRIBUTION PLANNING STANDARD
DPS-02

ISSUE DATE:	REVISION
September, 2015	02
	Page 68 of 78

A16. TABLE FOR VOLTAGE DROP (%) IN (400 V) WITH (185 MM² CABLE)

This Table shows the Voltage Drop (%) in (400 V) LV Network with LV Cable size (185 mm²) for different Coincident Demand Load (KVA) with different Cables' Length (m).

Nominal Voltage 400 V	Cable Size 185 mm ²	Voltage Drop (%)										PF = 0.85 Lag														
		20	40	60	80	100	120	140	160	180	200		220	240	260	280	300	320	340	360	380	400	420	440	460	480
CDL (kVA)	Length (m)																									
5	0.01	0.03	0.04	0.06	0.07	0.09	0.10	0.11	0.13	0.14	0.16	0.17	0.18	0.20	0.21	0.23	0.24	0.26	0.27	0.28	0.30	0.31	0.33	0.34	0.36	
10	0.03	0.06	0.09	0.11	0.14	0.17	0.20	0.23	0.26	0.28	0.31	0.34	0.37	0.40	0.43	0.45	0.48	0.51	0.54	0.57	0.60	0.63	0.65	0.68	0.71	
15	0.04	0.09	0.13	0.17	0.21	0.26	0.30	0.34	0.38	0.43	0.47	0.51	0.55	0.60	0.64	0.68	0.72	0.77	0.81	0.85	0.89	0.94	0.98	1.02	1.07	
20	0.06	0.11	0.17	0.23	0.28	0.34	0.40	0.45	0.51	0.57	0.63	0.68	0.74	0.80	0.85	0.91	0.97	1.02	1.08	1.14	1.19	1.25	1.31	1.36	1.42	
25	0.07	0.14	0.21	0.28	0.36	0.43	0.50	0.57	0.64	0.71	0.78	0.85	0.92	0.99	1.07	1.14	1.21	1.28	1.35	1.42	1.49	1.56	1.63	1.70	1.78	
30	0.09	0.17	0.26	0.34	0.43	0.51	0.60	0.68	0.77	0.85	0.94	1.02	1.11	1.19	1.28	1.36	1.45	1.53	1.62	1.70	1.79	1.88	1.96	2.05	2.13	
35	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.89	0.99	1.09	1.19	1.29	1.39	1.49	1.59	1.69	1.79	1.89	1.99	2.09	2.19	2.29	2.39	2.49	
40	0.11	0.23	0.34	0.45	0.57	0.68	0.80	0.91	1.02	1.14	1.25	1.36	1.48	1.59	1.70	1.82	1.93	2.05	2.16	2.27	2.39	2.50	2.61	2.73	2.84	
45	0.13	0.26	0.38	0.51	0.64	0.77	0.89	1.02	1.15	1.28	1.41	1.53	1.66	1.79	1.92	2.05	2.17	2.30	2.43	2.56	2.68	2.81	2.94	3.07	3.20	
50	0.14	0.28	0.43	0.57	0.71	0.85	0.99	1.14	1.28	1.42	1.56	1.70	1.85	1.99	2.13	2.27	2.41	2.56	2.70	2.84	2.98	3.13	3.27	3.41	3.55	
55	0.16	0.31	0.47	0.63	0.78	0.94	1.09	1.25	1.41	1.56	1.72	1.88	2.03	2.19	2.34	2.50	2.66	2.81	2.97	3.13	3.28	3.44	3.59	3.75	3.91	
60	0.17	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.70	1.88	2.05	2.22	2.39	2.56	2.73	2.90	3.07	3.24	3.41	3.58	3.75	3.92	4.09	4.26	
65	0.18	0.37	0.55	0.74	0.92	1.11	1.29	1.48	1.66	1.85	2.03	2.22	2.40	2.59	2.77	2.95	3.14	3.32	3.51	3.69	3.88	4.06	4.25	4.43	4.62	
70	0.20	0.40	0.60	0.80	0.99	1.19	1.39	1.59	1.79	1.99	2.19	2.39	2.59	2.78	2.98	3.18	3.38	3.58	3.78	3.98	4.18	4.38	4.57	4.77	4.97	
75	0.21	0.43	0.64	0.85	1.07	1.28	1.49	1.70	1.92	2.13	2.34	2.56	2.77	2.98	3.20	3.41	3.62	3.84	4.05	4.26	4.47	4.69	4.90	5.11	5.33	
80	0.23	0.45	0.68	0.91	1.14	1.36	1.59	1.82	2.05	2.27	2.50	2.73	2.95	3.18	3.41	3.64	3.86	4.09	4.32	4.55	4.77	5.00	5.23	5.45	5.68	
85	0.24	0.48	0.72	0.97	1.21	1.45	1.69	1.93	2.17	2.41	2.66	2.90	3.14	3.38	3.62	3.86	4.11	4.35	4.59	4.83	5.07	5.31	5.55	5.80	6.04	
90	0.26	0.51	0.77	1.02	1.28	1.53	1.79	2.05	2.30	2.56	2.81	3.07	3.32	3.58	3.84	4.09	4.35	4.60	4.86	5.11	5.37	5.63	5.88	6.14	6.39	
95	0.27	0.54	0.81	1.08	1.35	1.62	1.89	2.16	2.43	2.70	2.97	3.24	3.51	3.78	4.05	4.32	4.59	4.86	5.13	5.40	5.67	5.94	6.21	6.48	6.75	
100	0.28	0.57	0.85	1.14	1.42	1.70	1.99	2.27	2.56	2.84	3.13	3.41	3.69	3.98	4.26	4.55	4.83	5.11	5.40	5.68	5.97	6.25	6.53	6.82	7.10	
105	0.30	0.60	0.89	1.19	1.49	1.79	2.09	2.39	2.68	2.98	3.28	3.58	3.88	4.18	4.47	4.77	5.07	5.37	5.67	5.97	6.26	6.56	6.86	7.16	7.46	
110	0.31	0.63	0.94	1.25	1.56	1.88	2.19	2.50	2.81	3.13	3.44	3.75	4.06	4.38	4.69	5.00	5.31	5.63	5.94	6.25	6.56	6.88	7.19	7.50	7.81	
115	0.33	0.65	0.98	1.31	1.63	1.96	2.29	2.61	2.94	3.27	3.59	3.92	4.25	4.57	4.90	5.23	5.55	5.88	6.21	6.53	6.86	7.19	7.51	7.84	8.17	
120	0.34	0.68	1.02	1.36	1.70	2.05	2.39	2.73	3.07	3.41	3.75	4.09	4.43	4.77	5.11	5.45	5.80	6.14	6.48	6.82	7.16	7.50	7.84	8.18	8.52	
125	0.36	0.71	1.07	1.42	1.78	2.13	2.49	2.84	3.20	3.55	3.91	4.26	4.62	4.97	5.33	5.68	6.04	6.39	6.75	7.10	7.46	7.81	8.17	8.52	8.88	



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ISSUE DATE:	REVISION
September, 2015	02
	Page 69 of 78

A17. TABLE FOR VOLTAGE DROP (%) IN (400 V) WITH (70 MM² CABLE)

This Table shows the Voltage Drop (%) in (400 V) LV Network with LV Cable size (70 mm²) for different Coincident Demand Load (KVA) with different Cables' Length (m).

Nominal Voltage 400 V	Cable Size 70 mm ²	K Constant 3003	Voltage Drop (%)	PF = 0.85 Lag																								
				Length (m)	20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380	400	420	440	460	480
CDL (KVA)																												
5	0.03	0.07	0.10	0.13	0.17	0.20	0.23	0.27	0.30	0.33	0.37	0.40	0.43	0.47	0.50	0.53	0.57	0.60	0.63	0.67	0.70	0.73	0.77	0.80	0.83			
10	0.07	0.13	0.20	0.27	0.33	0.40	0.47	0.53	0.60	0.67	0.73	0.80	0.87	0.93	1.00	1.07	1.13	1.20	1.27	1.33	1.40	1.47	1.53	1.60	1.67			
15	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	1.00	1.10	1.20	1.30	1.40	1.50	1.60	1.70	1.80	1.90	2.00	2.10	2.20	2.30	2.40	2.50			
20	0.13	0.27	0.40	0.53	0.67	0.80	0.93	1.07	1.20	1.33	1.47	1.60	1.73	1.86	2.00	2.13	2.26	2.40	2.53	2.66	2.80	2.93	3.06	3.20	3.33			
25	0.17	0.33	0.50	0.67	0.83	1.00	1.17	1.33	1.50	1.67	1.83	2.00	2.16	2.33	2.50	2.66	2.83	3.00	3.16	3.33	3.50	3.66	3.83	4.00	4.16			
30	0.20	0.40	0.60	0.80	1.00	1.20	1.40	1.60	1.80	2.00	2.20	2.40	2.60	2.80	3.00	3.20	3.40	3.60	3.80	4.00	4.20	4.40	4.60	4.80	5.00			
35	0.23	0.47	0.70	0.93	1.17	1.40	1.63	1.86	2.10	2.33	2.56	2.80	3.03	3.26	3.50	3.73	3.96	4.20	4.43	4.66	4.90	5.13	5.36	5.59	5.83			
40	0.27	0.53	0.80	1.07	1.33	1.60	1.86	2.13	2.40	2.66	2.93	3.20	3.46	3.73	4.00	4.26	4.53	4.80	5.06	5.33	5.59	5.86	6.13	6.39	6.66			
45	0.30	0.60	0.90	1.20	1.50	1.80	2.10	2.40	2.70	3.00	3.30	3.60	3.90	4.20	4.50	4.80	5.10	5.40	5.69	5.99	6.29	6.59	6.89	7.19	7.49			
50	0.33	0.67	1.00	1.33	1.67	2.00	2.33	2.66	3.00	3.33	3.66	4.00	4.33	4.66	5.00	5.33	5.66	5.99	6.33	6.66	6.99	7.33	7.66	7.99	8.33			
55	0.37	0.73	1.10	1.47	1.83	2.20	2.56	2.93	3.30	3.66	4.03	4.40	4.76	5.13	5.49	5.86	6.23	6.59	6.96	7.33	7.69	8.06	8.43	8.79	9.16			
60	0.40	0.80	1.20	1.60	2.00	2.40	2.80	3.20	3.60	4.00	4.40	4.80	5.20	5.59	5.99	6.39	6.79	7.19	7.59	7.99	8.39	8.79	9.19	9.59	9.99			
65	0.43	0.87	1.30	1.73	2.16	2.60	3.03	3.46	3.90	4.33	4.76	5.20	5.63	6.06	6.49	6.93	7.36	7.79	8.23	8.66	9.09	9.52	9.96	10.39	10.82			
70	0.47	0.93	1.40	1.86	2.33	2.80	3.26	3.73	4.20	4.66	5.13	5.59	6.06	6.53	6.99	7.46	7.93	8.39	8.86	9.32	9.79	10.26	10.72	11.19	11.66			
75	0.50	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50	5.00	5.49	5.99	6.49	6.99	7.49	7.99	8.49	8.99	9.49	9.99	10.49	10.99	11.49	11.99	12.49			



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ISSUE DATE:	REVISION
September, 2015	02

Page 70 of 78

A18. TABLE FOR VOLTAGE DROP (%) IN (380 V) WITH (300 MM² CABLE)

This Table shows the Voltage Drop (%) in (380 V) LV Network with LV Cable size (300 mm²) for different Coincident Demand Load (KVA) with different Cables' Length (m).

Nominal Voltage 380 V	Cable Size 300 mm ²	K Constant 9144	Voltage Drop (%)	PF = 0.85 Lag																							
				20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380	400	420	440	460	480
CDL (kVA)																											
5	0.01	0.02	0.03	0.04	0.05	0.07	0.08	0.09	0.10	0.11	0.12	0.13	0.14	0.15	0.16	0.17	0.19	0.20	0.21	0.22	0.23	0.24	0.25	0.26	0.27		
10	0.02	0.04	0.07	0.09	0.11	0.13	0.15	0.17	0.20	0.22	0.24	0.26	0.28	0.31	0.33	0.35	0.37	0.39	0.42	0.44	0.46	0.48	0.50	0.52	0.55		
15	0.03	0.07	0.10	0.13	0.16	0.20	0.23	0.26	0.30	0.33	0.36	0.39	0.43	0.46	0.49	0.52	0.56	0.59	0.62	0.66	0.69	0.72	0.75	0.79	0.82		
20	0.04	0.09	0.13	0.17	0.22	0.26	0.31	0.35	0.39	0.44	0.48	0.52	0.57	0.61	0.66	0.70	0.74	0.79	0.83	0.87	0.92	0.96	1.01	1.05	1.09		
25	0.05	0.11	0.16	0.22	0.27	0.33	0.38	0.44	0.49	0.55	0.60	0.66	0.71	0.77	0.82	0.87	0.93	0.98	1.04	1.09	1.15	1.20	1.26	1.31	1.37		
30	0.07	0.13	0.20	0.26	0.33	0.39	0.46	0.52	0.59	0.66	0.72	0.79	0.85	0.92	0.98	1.05	1.12	1.18	1.25	1.31	1.38	1.44	1.51	1.57	1.64		
35	0.08	0.15	0.23	0.31	0.38	0.46	0.54	0.61	0.69	0.77	0.84	0.92	1.00	1.07	1.15	1.22	1.30	1.38	1.45	1.53	1.61	1.68	1.76	1.84	1.91		
40	0.09	0.17	0.26	0.35	0.44	0.52	0.61	0.70	0.79	0.87	0.96	1.05	1.14	1.22	1.31	1.40	1.49	1.57	1.66	1.75	1.84	1.92	2.01	2.10	2.19		
45	0.10	0.20	0.30	0.39	0.49	0.59	0.69	0.79	0.89	0.98	1.08	1.18	1.28	1.38	1.48	1.57	1.67	1.77	1.87	1.97	2.07	2.17	2.26	2.36	2.46		
50	0.11	0.22	0.33	0.44	0.55	0.66	0.77	0.87	0.98	1.09	1.20	1.31	1.42	1.53	1.64	1.75	1.86	1.97	2.08	2.19	2.30	2.41	2.52	2.62	2.73		
55	0.12	0.24	0.36	0.48	0.60	0.72	0.84	0.96	1.08	1.20	1.32	1.44	1.56	1.68	1.80	1.92	2.04	2.17	2.29	2.41	2.53	2.65	2.77	2.89	3.01		
60	0.13	0.26	0.39	0.52	0.66	0.79	0.92	1.05	1.18	1.31	1.44	1.57	1.71	1.84	1.97	2.10	2.23	2.36	2.49	2.62	2.76	2.89	3.02	3.15	3.28		
65	0.14	0.28	0.43	0.57	0.71	0.85	1.00	1.14	1.28	1.42	1.56	1.71	1.85	1.99	2.13	2.27	2.42	2.56	2.70	2.84	2.99	3.13	3.27	3.41	3.55		
70	0.15	0.31	0.46	0.61	0.77	0.92	1.07	1.22	1.38	1.53	1.68	1.84	1.99	2.14	2.30	2.45	2.60	2.76	2.91	3.06	3.22	3.37	3.52	3.67	3.83		
75	0.16	0.33	0.49	0.66	0.82	0.98	1.15	1.31	1.48	1.64	1.80	1.97	2.13	2.30	2.46	2.62	2.79	2.95	3.12	3.28	3.44	3.61	3.77	3.94	4.10		
80	0.17	0.35	0.52	0.70	0.87	1.05	1.22	1.40	1.57	1.75	1.92	2.10	2.27	2.45	2.62	2.80	2.97	3.15	3.32	3.50	3.67	3.85	4.02	4.20	4.37		
85	0.19	0.37	0.56	0.74	0.93	1.12	1.30	1.49	1.67	1.86	2.04	2.23	2.42	2.60	2.79	2.97	3.16	3.35	3.53	3.72	3.90	4.09	4.28	4.46	4.65		
90	0.20	0.39	0.59	0.79	0.98	1.18	1.38	1.57	1.77	1.97	2.17	2.36	2.56	2.76	2.95	3.15	3.35	3.54	3.74	3.94	4.13	4.33	4.53	4.72	4.92		
95	0.21	0.42	0.62	0.83	1.04	1.25	1.45	1.66	1.87	2.08	2.29	2.49	2.70	2.91	3.12	3.32	3.53	3.74	3.95	4.16	4.36	4.57	4.78	4.99	5.19		
100	0.22	0.44	0.66	0.87	1.09	1.31	1.53	1.75	1.97	2.19	2.41	2.62	2.84	3.06	3.28	3.50	3.72	3.94	4.16	4.37	4.59	4.81	5.03	5.25	5.47		
105	0.23	0.46	0.69	0.92	1.15	1.38	1.61	1.84	2.07	2.30	2.53	2.76	2.99	3.22	3.44	3.67	3.90	4.13	4.36	4.59	4.82	5.05	5.28	5.51	5.74		
110	0.24	0.48	0.72	0.96	1.20	1.44	1.68	1.92	2.17	2.41	2.65	2.89	3.13	3.37	3.61	3.85	4.09	4.33	4.57	4.81	5.05	5.29	5.53	5.77	6.01		
115	0.25	0.50	0.75	1.01	1.26	1.51	1.76	2.01	2.26	2.52	2.77	3.02	3.27	3.52	3.77	4.02	4.28	4.53	4.78	5.03	5.28	5.53	5.78	6.04	6.29		
120	0.26	0.52	0.79	1.05	1.31	1.57	1.84	2.10	2.36	2.62	2.89	3.15	3.41	3.67	3.94	4.20	4.46	4.72	4.99	5.25	5.51	5.77	6.04	6.30	6.56		
125	0.27	0.55	0.82	1.09	1.37	1.64	1.91	2.19	2.46	2.73	3.01	3.28	3.55	3.83	4.10	4.37	4.65	4.92	5.19	5.47	5.74	6.01	6.29	6.56	6.83		
130	0.28	0.57	0.85	1.14	1.42	1.71	1.99	2.27	2.56	2.84	3.13	3.41	3.70	3.98	4.26	4.55	4.83	5.12	5.40	5.69	5.97	6.26	6.54	6.82	7.11		
135	0.30	0.59	0.89	1.18	1.48	1.77	2.07	2.36	2.66	2.95	3.25	3.54	3.84	4.13	4.43	4.72	5.02	5.31	5.61	5.91	6.20	6.50	6.79	7.09	7.38		
140	0.31	0.61	0.92	1.22	1.53	1.84	2.14	2.45	2.76	3.06	3.37	3.67	3.98	4.29	4.59	4.90	5.21	5.51	5.82	6.12	6.43	6.74	7.04	7.35	7.65		
145	0.32	0.63	0.95	1.27	1.59	1.90	2.22	2.54	2.85	3.17	3.49	3.81	4.12	4.44	4.76	5.07	5.39	5.71	6.03	6.34	6.66	6.98	7.29	7.61	7.93		
150	0.33	0.66	0.98	1.31	1.64	1.97	2.30	2.62	2.95	3.28	3.61	3.94	4.26	4.59	4.92	5.25	5.58	5.91	6.23	6.56	6.89	7.22	7.55	7.87	8.20		
155	0.34	0.68	1.02	1.36	1.70	2.03	2.37	2.71	3.05	3.39	3.73	4.07	4.41	4.75	5.09	5.42	5.76	6.10	6.44	6.78	7.12	7.46	7.80	8.14	8.48		
160	0.35	0.70	1.05	1.40	1.75	2.10	2.45	2.80	3.15	3.50	3.85	4.20	4.55	4.90	5.25	5.60	5.95	6.30	6.65	7.00	7.35	7.70	8.05	8.40	8.75		



الشركة السعودية للكهرباء

Saudi Electricity Company

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Design Guideline Of Underground Low
Voltage Network To Supply Customers

DISTRIBUTION PLANNING STANDARD
DPS-02

ISSUE DATE:	REVISION
September, 2015	02
	Page 71 of 78

A19. TABLE FOR VOLTAGE DROP (%) IN (380 V) WITH (185 MM² CABLE)

This Table shows the Voltage Drop (%) in (380 V) LV Network with LV Cable size (185 mm²) for different Coincident Demand Load (KVA) with different Cables' Length (m).

Nominal Voltage 380 V	Cable Size 185 mm ²	K Constant 6353	Voltage Drop (%)	PF = 0.85 Lag																								
				20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380	400	420	440	460	480	500
CDL (kVA)																												
5	0.02	0.03	0.05	0.06	0.08	0.09	0.11	0.13	0.14	0.16	0.17	0.19	0.20	0.22	0.24	0.25	0.27	0.28	0.30	0.31	0.33	0.35	0.36	0.38	0.39			
10	0.03	0.06	0.09	0.13	0.16	0.19	0.22	0.25	0.28	0.31	0.35	0.38	0.41	0.44	0.47	0.50	0.54	0.57	0.60	0.63	0.66	0.69	0.72	0.76	0.79			
15	0.05	0.09	0.14	0.19	0.24	0.28	0.33	0.38	0.42	0.47	0.52	0.57	0.61	0.66	0.71	0.76	0.80	0.85	0.90	0.94	0.99	1.04	1.09	1.13	1.18			
20	0.06	0.13	0.19	0.25	0.31	0.38	0.44	0.50	0.57	0.63	0.69	0.76	0.82	0.88	0.94	1.01	1.07	1.13	1.20	1.26	1.32	1.39	1.45	1.51	1.57			
25	0.08	0.16	0.24	0.31	0.39	0.47	0.55	0.63	0.71	0.79	0.87	0.94	1.02	1.10	1.18	1.26	1.34	1.42	1.50	1.57	1.65	1.73	1.81	1.89	1.97			
30	0.09	0.19	0.28	0.38	0.47	0.57	0.66	0.76	0.85	0.94	1.04	1.13	1.23	1.32	1.42	1.51	1.61	1.70	1.79	1.89	1.98	2.08	2.17	2.27	2.36			
35	0.11	0.22	0.33	0.44	0.55	0.66	0.77	0.88	0.99	1.10	1.21	1.32	1.43	1.54	1.65	1.76	1.87	1.98	2.09	2.20	2.31	2.42	2.53	2.64	2.75			
40	0.13	0.25	0.38	0.50	0.63	0.76	0.88	1.01	1.13	1.26	1.39	1.51	1.64	1.76	1.89	2.01	2.14	2.27	2.39	2.52	2.64	2.77	2.90	3.02	3.15			
45	0.14	0.28	0.42	0.57	0.71	0.85	0.99	1.13	1.27	1.42	1.56	1.70	1.84	1.98	2.12	2.27	2.41	2.55	2.69	2.83	2.97	3.12	3.26	3.40	3.54			
50	0.16	0.31	0.47	0.63	0.79	0.94	1.10	1.26	1.42	1.57	1.73	1.89	2.05	2.20	2.36	2.52	2.68	2.83	2.99	3.15	3.31	3.46	3.62	3.78	3.94			
55	0.17	0.35	0.52	0.69	0.87	1.04	1.21	1.39	1.56	1.73	1.90	2.08	2.25	2.42	2.60	2.77	2.94	3.12	3.29	3.46	3.64	3.81	3.98	4.16	4.33			
60	0.19	0.38	0.57	0.76	0.94	1.13	1.32	1.51	1.70	1.89	2.08	2.27	2.46	2.64	2.83	3.02	3.21	3.40	3.59	3.78	3.97	4.16	4.34	4.53	4.72			
65	0.20	0.41	0.61	0.82	1.02	1.23	1.43	1.64	1.84	2.05	2.25	2.46	2.66	2.86	3.07	3.27	3.48	3.68	3.89	4.09	4.30	4.50	4.71	4.91	5.12			
70	0.22	0.44	0.66	0.88	1.10	1.32	1.54	1.76	1.98	2.20	2.42	2.64	2.86	3.09	3.31	3.53	3.75	3.97	4.19	4.41	4.63	4.85	5.07	5.29	5.51			
75	0.24	0.47	0.71	0.94	1.18	1.42	1.65	1.89	2.12	2.36	2.60	2.83	3.07	3.31	3.54	3.78	4.01	4.25	4.49	4.72	4.96	5.19	5.43	5.67	5.90			
80	0.25	0.50	0.76	1.01	1.26	1.51	1.76	2.01	2.27	2.52	2.77	3.02	3.27	3.53	3.78	4.03	4.28	4.53	4.78	5.04	5.29	5.54	5.79	6.04	6.30			
85	0.27	0.54	0.80	1.07	1.34	1.61	1.87	2.14	2.41	2.68	2.94	3.21	3.48	3.75	4.01	4.28	4.55	4.82	5.08	5.35	5.62	5.89	6.15	6.42	6.69			
90	0.28	0.57	0.85	1.13	1.42	1.70	1.98	2.27	2.55	2.83	3.12	3.40	3.68	3.97	4.25	4.53	4.82	5.10	5.38	5.67	5.95	6.23	6.52	6.80	7.08			
95	0.30	0.60	0.90	1.20	1.50	1.79	2.09	2.39	2.69	2.99	3.29	3.59	3.89	4.19	4.49	4.78	5.08	5.38	5.68	5.98	6.28	6.58	6.88	7.18	7.48			
100	0.31	0.63	0.94	1.26	1.57	1.89	2.20	2.52	2.83	3.15	3.46	3.78	4.09	4.41	4.72	5.04	5.35	5.67	5.98	6.30	6.61	6.93	7.24	7.56	7.87			
105	0.33	0.66	0.99	1.32	1.65	1.98	2.31	2.64	2.97	3.31	3.64	3.97	4.30	4.63	4.96	5.29	5.62	5.95	6.28	6.61	6.94	7.27	7.60	7.93	8.26			
110	0.35	0.69	1.04	1.39	1.73	2.08	2.42	2.77	3.12	3.46	3.81	4.16	4.50	4.85	5.19	5.54	5.89	6.23	6.58	6.93	7.27	7.62	7.96	8.31	8.66			
115	0.36	0.72	1.09	1.45	1.81	2.17	2.53	2.90	3.26	3.62	3.98	4.34	4.71	5.07	5.43	5.79	6.15	6.52	6.88	7.24	7.60	7.96	8.33	8.69	9.05			
120	0.38	0.76	1.13	1.51	1.89	2.27	2.64	3.02	3.40	3.78	4.16	4.53	4.91	5.29	5.67	6.04	6.42	6.80	7.18	7.56	7.93	8.31	8.69	9.07	9.44			



الشركة السعودية للكهرباء

Saudi Electricity Company

**DISTRIBUTION PLANNING STANDARD
Design Guideline Of Underground Low
Voltage Network To Supply Customers**

**DISTRIBUTION PLANNING STANDARD
DPS-02**

ISSUE DATE:

September, 2015

REVISION

02

Page 72 of 78

A20. TABLE FOR VOLTAGE DROP (%) IN (380 V) WITH (70 MM² CABLE)

This Table shows the Voltage Drop (%) in (380 V) LV Network with LV Cable size (70 mm²) for different Coincident Demand Load (KVA) with different Cables' Length (m).

Nominal Voltage 380 V	Cable Size 70 mm ²										K Constant	2710	Voltage Drop (%)	PF = 0.85 Lag
	Length (m)	20	40	60	80	100	120	140	160	180				
CDL (kVA)														
5	0.04	0.07	0.11	0.15	0.18	0.22	0.26	0.30	0.33	0.37	0.41	0.44	0.48	0.52
10	0.07	0.15	0.22	0.30	0.37	0.44	0.52	0.59	0.66	0.74	0.81	0.89	0.96	1.03
15	0.11	0.22	0.33	0.44	0.55	0.66	0.77	0.89	1.00	1.11	1.22	1.33	1.44	1.55
20	0.15	0.30	0.44	0.59	0.74	0.89	1.03	1.18	1.33	1.48	1.62	1.77	1.92	2.07
25	0.18	0.37	0.55	0.74	0.92	1.11	1.29	1.48	1.66	1.85	2.03	2.21	2.40	2.58
30	0.22	0.44	0.66	0.89	1.11	1.33	1.55	1.77	1.99	2.21	2.44	2.66	2.88	3.10
35	0.26	0.52	0.77	1.03	1.29	1.55	1.81	2.07	2.32	2.58	2.84	3.10	3.36	3.62
40	0.30	0.59	0.89	1.18	1.48	1.77	2.07	2.36	2.66	2.95	3.25	3.54	3.84	4.13
45	0.33	0.66	1.00	1.33	1.66	1.99	2.32	2.66	2.99	3.32	3.65	3.99	4.32	4.65
50	0.37	0.74	1.11	1.48	1.85	2.21	2.58	2.95	3.32	3.69	4.06	4.43	4.80	5.17
55	0.41	0.81	1.22	1.62	2.03	2.44	2.84	3.25	3.65	4.06	4.46	4.87	5.28	5.68
60	0.44	0.89	1.33	1.77	2.21	2.66	3.10	3.54	3.99	4.43	4.87	5.31	5.76	6.20
65	0.48	0.96	1.44	1.92	2.40	2.88	3.36	3.84	4.32	4.80	5.28	5.76	6.24	6.72
70	0.52	1.03	1.55	2.07	2.58	3.10	3.62	4.13	4.65	5.17	5.68	6.20	6.72	7.23



الشركة السعودية للكهرباء

Saudi Electricity Company

**DISTRIBUTION PLANNING STANDARD
Design Guideline Of Underground Low
Voltage Network To Supply Customers**

**DISTRIBUTION PLANNING STANDARD
DPS-02**

ISSUE DATE:
September, 2015

REVISION
02

Page 73 of 78

A21. TABLE FOR VOLTAGE DROP (%) IN (220 V) WITH (300 MM² CABLE)

This Table shows the Voltage Drop (%) in (220 V) LV Network with LV Cable size (300 mm²) for different Coincident Demand Load (KVA) with different Cables' Length (m).

Nominal Voltage 220 V	Cable Size 300 mm ²	K Constant										PF = 0.85 Lag														
		3065	3065	3065	3065	3065	3065	3065	3065	3065	3065															
Length (m)	20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380	400	420	440	460	480	500	
CDL (KVA)																										
5	0.03	0.07	0.10	0.13	0.16	0.20	0.23	0.26	0.29	0.33	0.36	0.39	0.42	0.46	0.49	0.52	0.55	0.59	0.62	0.65	0.69	0.72	0.75	0.78	0.82	
10	0.07	0.13	0.20	0.26	0.33	0.39	0.46	0.52	0.59	0.65	0.72	0.78	0.85	0.91	0.98	1.04	1.11	1.17	1.24	1.31	1.37	1.44	1.50	1.57	1.63	
15	0.10	0.20	0.29	0.39	0.49	0.59	0.69	0.78	0.88	0.98	1.08	1.17	1.27	1.37	1.47	1.57	1.66	1.76	1.86	1.96	2.06	2.15	2.25	2.35	2.45	
20	0.13	0.26	0.39	0.52	0.65	0.78	0.91	1.04	1.17	1.31	1.44	1.57	1.70	1.83	1.96	2.09	2.22	2.35	2.48	2.61	2.74	2.87	3.00	3.13	3.26	
25	0.16	0.33	0.49	0.65	0.82	0.98	1.14	1.31	1.47	1.63	1.79	1.96	2.12	2.28	2.45	2.61	2.77	2.94	3.10	3.26	3.43	3.59	3.75	3.92	4.08	
30	0.20	0.39	0.59	0.78	0.98	1.17	1.37	1.57	1.76	1.96	2.15	2.35	2.54	2.74	2.94	3.13	3.33	3.52	3.72	3.92	4.11	4.31	4.50	4.70	4.89	
35	0.23	0.46	0.69	0.91	1.14	1.37	1.60	1.83	2.06	2.28	2.51	2.74	2.97	3.20	3.43	3.65	3.88	4.11	4.34	4.57	4.80	5.02	5.25	5.48	5.71	
40	0.26	0.52	0.78	1.04	1.31	1.57	1.83	2.09	2.35	2.61	2.87	3.13	3.39	3.65	3.92	4.18	4.44	4.70	4.96	5.22	5.48	5.74	6.00	6.26	6.53	
45	0.29	0.59	0.88	1.17	1.47	1.76	2.06	2.35	2.64	2.94	3.23	3.52	3.82	4.11	4.40	4.70	4.99	5.29	5.58	5.87	6.17	6.46	6.75	7.05	7.34	
50	0.33	0.65	0.98	1.31	1.63	1.96	2.28	2.61	2.94	3.26	3.59	3.92	4.24	4.57	4.89	5.22	5.55	5.87	6.20	6.53	6.85	7.18	7.50	7.83	8.16	
55	0.36	0.72	1.08	1.44	1.79	2.15	2.51	2.87	3.23	3.59	3.95	4.31	4.67	5.02	5.38	5.74	6.10	6.46	6.82	7.18	7.54	7.90	8.25	8.61	8.97	
60	0.39	0.78	1.17	1.57	1.96	2.35	2.74	3.13	3.52	3.92	4.31	4.70	5.09	5.48	5.87	6.26	6.66	7.05	7.44	7.83	8.22	8.61	9.00	9.40	9.79	
65	0.42	0.85	1.27	1.70	2.12	2.54	2.97	3.39	3.82	4.24	4.67	5.09	5.51	5.94	6.36	6.79	7.21	7.63	8.06	8.48	8.91	9.33	9.76	10.18	10.60	
70	0.46	0.91	1.37	1.83	2.28	2.74	3.20	3.65	4.11	4.57	5.02	5.48	5.94	6.39	6.85	7.31	7.77	8.22	8.68	9.14	9.59	10.05	10.51	10.96	11.42	
75	0.49	0.98	1.47	1.96	2.45	2.94	3.43	3.92	4.40	4.89	5.38	5.87	6.36	6.85	7.34	7.83	8.32	8.81	9.30	9.79	10.28	10.77	11.26	11.75	12.23	
80	0.52	1.04	1.57	2.09	2.61	3.13	3.65	4.18	4.70	5.22	5.74	6.26	6.79	7.31	7.83	8.35	8.87	9.40	9.92	10.44	10.96	11.48	12.01	12.53	13.05	
85	0.55	1.11	1.66	2.22	2.77	3.33	3.88	4.44	4.99	5.55	6.10	6.66	7.21	7.77	8.32	8.87	9.43	9.98	10.54	11.09	11.65	12.20	12.76	13.31	13.87	
90	0.59	1.17	1.76	2.35	2.94	3.52	4.11	4.70	5.29	5.87	6.46	7.05	7.63	8.22	8.81	9.40	9.98	10.57	11.16	11.75	12.33	12.92	13.51	14.09	14.68	
95	0.62	1.24	1.86	2.48	3.10	3.72	4.34	4.96	5.58	6.20	6.82	7.44	8.06	8.68	9.30	9.92	10.54	11.16	11.78	12.40	13.02	13.64	14.26	14.88	15.50	



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Saudi Electricity Company

**DISTRIBUTION PLANNING STANDARD
Design Guideline Of Underground Low
Voltage Network To Supply Customers**

**DISTRIBUTION PLANNING STANDARD
DPS-02**

ISSUE DATE:	REVISION
September, 2015	02
	Page 74 of 78

A22. TABLE FOR VOLTAGE DROP (%) IN (220 V) WITH (185 MM² CABLE)

This Table shows the Voltage Drop (%) in (220 V) LV Network with LV Cable size (185 mm²) for different Coincident Demand Load (KVA) with different Cables' Length (m).

Nominal Voltage 220 V	Cable Size 185 mm ²	K Constant	2129	Voltage Drop (%)	PF = 0.85 Lag																						
					20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380	400	420	440	460
5	0.05	0.14	0.19	0.23	0.28	0.33	0.38	0.42	0.47	0.52	0.56	0.61	0.66	0.70	0.75	0.80	0.85	0.89	0.94	0.99	1.03	1.08	1.13	1.17			
10	0.09	0.19	0.28	0.38	0.47	0.56	0.66	0.75	0.85	0.94	1.03	1.13	1.22	1.31	1.41	1.50	1.60	1.69	1.78	1.88	1.97	2.07	2.16	2.25	2.35		
15	0.14	0.28	0.42	0.56	0.70	0.85	0.99	1.13	1.27	1.41	1.55	1.69	1.83	1.97	2.11	2.25	2.39	2.54	2.68	2.82	2.96	3.10	3.24	3.38	3.52		
20	0.19	0.38	0.56	0.75	0.94	1.13	1.31	1.50	1.69	1.88	2.07	2.25	2.44	2.63	2.82	3.01	3.19	3.38	3.57	3.76	3.94	4.13	4.32	4.51	4.70		
25	0.23	0.47	0.70	0.94	1.17	1.41	1.64	1.88	2.11	2.35	2.58	2.82	3.05	3.29	3.52	3.76	3.99	4.23	4.46	4.70	4.93	5.17	5.40	5.64	5.87		
30	0.28	0.56	0.85	1.13	1.41	1.69	1.97	2.25	2.54	2.82	3.10	3.38	3.66	3.94	4.23	4.51	4.79	5.07	5.35	5.64	5.92	6.20	6.48	6.76	7.04		
35	0.33	0.66	0.99	1.31	1.64	1.97	2.30	2.63	2.96	3.29	3.62	3.94	4.27	4.60	4.93	5.26	5.59	5.92	6.25	6.57	6.90	7.23	7.56	7.89	8.22		
40	0.38	0.75	1.13	1.50	1.88	2.25	2.63	3.01	3.38	3.76	4.13	4.51	4.88	5.26	5.64	6.01	6.39	6.76	7.14	7.51	7.89	8.26	8.64	9.02	9.39		
45	0.42	0.85	1.27	1.69	2.11	2.54	2.96	3.38	3.80	4.23	4.65	5.07	5.49	5.92	6.34	6.76	7.18	7.61	8.03	8.45	8.88	9.30	9.72	10.14	10.57		
50	0.47	0.94	1.41	1.88	2.35	2.82	3.29	3.76	4.23	4.70	5.17	5.64	6.10	6.57	7.04	7.51	7.98	8.45	8.92	9.39	9.86	10.33	10.80	11.27	11.74		
55	0.52	1.03	1.55	2.07	2.58	3.10	3.62	4.13	4.65	5.17	5.68	6.20	6.72	7.23	7.75	8.26	8.78	9.30	9.81	10.33	10.85	11.36	11.88	12.40	12.91		
60	0.56	1.13	1.69	2.25	2.82	3.38	3.94	4.51	5.07	5.64	6.20	6.76	7.33	7.89	8.45	9.02	9.58	10.14	10.71	11.27	11.83	12.40	12.96	13.52	14.09		
65	0.61	1.22	1.83	2.44	3.05	3.66	4.27	4.88	5.49	6.10	6.72	7.33	7.94	8.55	9.16	9.77	10.38	10.99	11.60	12.21	12.82	13.43	14.04	14.65	15.26		
70	0.66	1.31	1.97	2.63	3.29	3.94	4.60	5.26	5.92	6.57	7.23	7.89	8.55	9.20	9.86	10.52	11.18	11.83	12.49	13.15	13.81	14.46	15.12	15.78	16.44		



الشركة السعودية للكهرباء

Saudi Electricity Company

**DISTRIBUTION PLANNING STANDARD
Design Guideline Of Underground Low
Voltage Network To Supply Customers**

**DISTRIBUTION PLANNING STANDARD
DPS-02**

ISSUE DATE:

September, 2015

REVISION

02

Page 75 of 78

A23. TABLE FOR VOLTAGE DROP (%) IN (220 V) WITH (70 MM² CABLE)

This Table shows the Voltage Drop (%) in (220 V) LV Network with LV Cable size (70 mm²) for different Coincident Demand Load (KVA) with different Cables' Length (m).

Nominal Voltage 220 V	Cable Size		70 mm ²		K Constant	908	Voltage Drop (%)	PF = 0.85 Lag	500																
	Length (m)	CDL (KVA)	20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380	400	420	440	460
5	0.11	0.22	0.33	0.44	0.55	0.66	0.77	0.88	0.99	1.10	1.21	1.32	1.43	1.54	1.65	1.76	1.87	1.98	2.09	2.20	2.31	2.42	2.53	2.64	2.75
10	0.22	0.44	0.66	0.88	1.10	1.32	1.54	1.76	1.98	2.20	2.42	2.64	2.86	3.08	3.30	3.52	3.74	3.96	4.18	4.40	4.62	4.84	5.06	5.28	5.50
15	0.33	0.66	0.99	1.32	1.65	1.98	2.31	2.64	2.97	3.30	3.63	3.96	4.29	4.62	4.95	5.28	5.61	5.94	6.28	6.61	6.94	7.27	7.60	7.93	8.26
20	0.44	0.88	1.32	1.76	2.20	2.64	3.08	3.52	3.96	4.40	4.84	5.28	5.72	6.17	6.61	7.05	7.49	7.93	8.37	8.81	9.25	9.69	10.13	10.57	11.01
25	0.55	1.10	1.65	2.20	2.75	3.30	3.85	4.40	4.95	5.50	6.06	6.61	7.16	7.71	8.26	8.81	9.36	9.91	10.46	11.01	11.56	12.11	12.66	13.21	13.76
30	0.66	1.32	1.98	2.64	3.30	3.96	4.62	5.28	5.94	6.61	7.27	7.93	8.59	9.25	9.91	10.57	11.23	11.89	12.55	13.21	13.87	14.53	15.19	15.85	16.51
35	0.77	1.54	2.31	3.08	3.85	4.62	5.39	6.17	6.94	7.71	8.48	9.25	10.02	10.79	11.56	12.33	13.10	13.87	14.64	15.41	16.18	16.95	17.72	18.50	19.27
40	0.88	1.76	2.64	3.52	4.40	5.28	6.17	7.05	7.93	8.81	9.69	10.57	11.45	12.33	13.21	14.09	14.97	15.85	16.73	17.61	18.50	19.38	20.26	21.14	22.02



الشركة السعودية للكهرباء

Saudi Electricity Company

**DISTRIBUTION PLANNING STANDARD
Design Guideline Of Underground Low
Voltage Network To Supply Customers**

DISTRIBUTION PLANNING STANDARD
DPS-02

ISSUE DATE:

September, 2015

REVISION

02

Page 76 of 78

A24. TABLE FOR DEMAND FACTOR VALUES

This Table shows the Demand Factor Values for different Customer Category Types according to SEC Distribution Planning Standards No.(DPS-01, Rev.02) titled (Estimation of Customer Load Guideline).

Code	Customer Category	Demand Factor (DF)
C1	Normal Residential Dwelling	0.60
C2	Normal Commercial Shops	0.70
C3	Furnished Flats	0.70
C4	Hotels	0.75
C5	Malls	0.70
C6	Restaurants	0.70
C7	Offices	0.70
C8	Schools	0.80
C9	Mosques	0.90
C10	Mezzanine in Hotel	0.75
C11	Common Area/Services in Buildings	0.80
C12	Public Services Facilities	0.75
C13	Indoor Parking	0.80
C14	Outdoor Parking	0.90
C15	Streets Lighting	0.90
C16	Parks & Garden	0.80
C17	Open Spaces	0.90
C18	Hospitals\Medical Facilities	0.80
C19	Medical Clinics	0.70
C20	Universities/High Educational Facilities	0.80
C21	Light Industries	0.90
C22	Workshops	0.60
C23	Cooling Stores	0.90
C24	Warehouses	0.70
C25	Community Halls	0.80
C26	Recreational Facilities	0.80
C27	Farms\Agricultural Facilities	0.90
C28	Fuel Stations	0.70
C29	Bulk Factories	0.90



الشركة السعودية للكهرباء

Saudi Electricity Company

**DISTRIBUTION PLANNING STANDARD
Design Guideline Of Underground Low
Voltage Network To Supply Customers**

DISTRIBUTION PLANNING STANDARD
DPS-02

ISSUE DATE:

REVISION

September, 2015

02

Page 77 of 78

A25. TABLE FOR COINCIDENT FACTOR VALUES

This Table shows the Coincident Factor Values for different Number of Meters according to SEC Distribution Planning Standards No.(DPS-01, Rev.02) titled (Estimation of Customer Load Guideline).

Number of Meters N	Coincident Factor CF(N)	Number of Meters N	Coincident Factor CF(N)	Number of Meters N	Coincident Factor CF(N)
1	1.000	34	0.581	67	0.568
2	0.723	35	0.581	68	0.568
3	0.688	36	0.580	69	0.568
4	0.668	37	0.579	70	0.568
5	0.654	38	0.579	71	0.567
6	0.644	39	0.578	72	0.567
7	0.636	40	0.578	73	0.567
8	0.629	41	0.577	74	0.567
9	0.624	42	0.577	75	0.566
10	0.619	43	0.576	76	0.566
11	0.616	44	0.576	77	0.566
12	0.612	45	0.575	78	0.566
13	0.609	46	0.575	79	0.566
14	0.607	47	0.575	80	0.566
15	0.604	48	0.574	81	0.565
16	0.602	49	0.574	82	0.565
17	0.600	50	0.573	83	0.565
18	0.598	51	0.573	84	0.565
19	0.597	52	0.573	85	0.565
20	0.595	53	0.572	86	0.564
21	0.594	54	0.572	87	0.564
22	0.592	55	0.572	88	0.564
23	0.591	56	0.571	89	0.564
24	0.590	57	0.571	90	0.564
25	0.589	58	0.571	91	0.564
26	0.588	59	0.570	92	0.564
27	0.587	60	0.570	93	0.563
28	0.586	61	0.570	94	0.563
29	0.585	62	0.570	95	0.563
30	0.584	63	0.569	96	0.563
31	0.583	64	0.569	97	0.563
32	0.583	65	0.569	98	0.563
33	0.582	66	0.568	99	0.563



الشركة السعودية للكهرباء

Saudi Electricity Company

**DISTRIBUTION PLANNING STANDARD
Design Guideline Of Underground Low
Voltage Network To Supply Customers**

DISTRIBUTION PLANNING STANDARD
DPS-02

ISSUE DATE:

September, 2015

REVISION

02

Page 78 of 78

A26. REFERENCES

This Guideline should be read in conjunction with all References mentioned in the Table below which includes all related SEC Distribution Material and Construction Specifications for Underground LV Network.

SN	CODE	ITEM DESCRIPTION	REV.	DATE
1		SEC Customers Services Manual		
2	01-SDMS-01	General Requirements For All Equipment / Material	1	12/2003
3	11-SDMS-01	Low Voltage Power And Control Cables	2	03/2007
4	12-SDMS-02	Lugs And Connectors For MV/LV Distribution System	2	03/2007
5	31-SDMS-01	Low Voltage Distribution Panel	3	03/2010
6	31-SDMS-02	L V Distribution Pillar	1	04/2004
7	31-SDMS-04	Low Voltage Distribution Panel Without Outgoing Circuit Breakers	0	01/2007
8	31-SDMS-05	400/230 Volts Low Voltage Distribution Panel	0	09/2010
9	31-SDMS-06	400/230 Volts Low Voltage Distribution Panel Without Outgoing Circuit Breakers	0	10/2010
10	34-SDMS-02	M V & L V fuse links	0	10/2003
11	37-SDMS-01	Low Voltage Molded Case Circuit Breakers For Service Connections	3	10/2014
12	37-SDMS-02	Molded Case Circuit Breakers For Low Voltage Distribution Panels 400 Amps	0	01/2006
13	37-SDMS-04	Interface Low Voltage Main Circuit Breakers	0	02/2006
14	38-SDMS-03	LV Digital Panel Meters	0	07/2009
15	40-SDMS-01	Bottom Connected Kilo-Watt-hour Meter	2	09/2010
16	40-SDMS-02A	Electronic Revenue CT And CT/VT Meters	7	03/2014
17	40-SDMS-02B	Electronic Revenue Whole- Current Meters	6	02/2012
18	42-SDMS-01	Fiber Glass Reinforced Polyester Meter Boxes	4	11/2007
19	42-SDMS-02	Fiberglass Reinforced Low Voltage Service Cabinet For 800A Bulk Customers	0	08/2007
20	42-SDMS-03	Inside Room Fiberglass Reinforced Polyester Meter Boxes	0	12/2007
21	51-SDMS-01	Distribution Transformers Up To 36KV	2	04/2004
22	51-SDMS-02	Distribution Transformers Up To 36kv 400/230 Volts	0	09/2010
23	56-SDMS-01	13.8KV Unit Substations	1	04/2004
24	56-SDMS-02	13.8KV Package Substations	1	04/2004
25	56-SDMS-03	13.8KV Unit Substations 400/230 V	0	10/2010
26	56-SDMS-04	Specifications for 13.8kv Package Substations 400/230 Volts	0	10/2010
27	SDCS-02	PART 1 - CABLE TRENCHES AND CONCRETE FOUNDATIONS	0	05/2005
28	SDCS-02	PART 2 - INSTALLATION OF KWH METERS INSIDE METER ROOMS AND INSETS	0	05/2005
29	SDCS-02	PART 3 - INSTALLATION OF RECESSED TYPE KWH METER BOXES INTO CONSUMER'S WALL	1	01/2009
30	SDCS-02	PART 4 - INSTALLATION OF DISTRIBUTION PILLARS	0	02/2006
31	SDCS-02	PART 5 - INSTALLATION OF FIBERGLASS REINFORCED LOW VOLTAGE SERVICE CABINET FOR 800 A CONSUMERS	0	01/2009